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# Conceptual Development of a Toxic Screening Model

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# CONCEPTUAL DEVELOPMENT OF A TOXIC SCREENING MODEL

by

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## FOREWORD

The U.S. Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimonies to the deterioration of our natural environment. The complexity of that environment and the interplay of its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution, and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems to prevent, treat, and manage wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, to preserve and treat public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research and is a most vital communications link between the researcher and the user community.

This report presents the application of the Routing and Graphical Display System developed by EPA to show how computer based modeling and simulation using the Reach File can be used to assess the types and concentrations of contaminants that could be found at any point in a river, using the Lower Mississippi River as an initial application.

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## ABSTRACT

A preliminary study was performed to evaluate the application of the Routing and Graphical Display System developed by USEPA to show how computer-based modeling and simulation can be used to assess the types and concentrations of contaminants that might exist in the lower Mississippi River. The approach used for determining the extent of these contaminants has considerable potential for application to other major river systems.

Three types of files maintained by U.S. EPA were used. These were as follows:

- The Analytical Reach File (AR File) - which is a computerized data file of over 68,000 stream "reaches" (i.e., a stretch of river uniquely defined by an upstream and downstream point) containing base data on length, flow, etc. and a description of the connectivity between "reaches".

- The Industrial Facilities Discharge File (IFD) which is a computerized data file on industrial discharges by SIC number, containing discharge flow data and reach identification for each discharger.

- The Pollutant Matrix File (PMF) - which is a computerized file containing representative concentrations of eleven (11) selected pollutants (ten heavy metals and phenol) for the above discharge categories under varying treatment levels. For the purpose of this study, this file was expanded to include representative discharge concentrations for selected organic pollutants.

In addition, because the analyses were to focus on organic pollutants/contaminants, stream monitoring data available from a USEPA research project in Jefferson Parish, Louisiana were used to develop a supplemental data base. These data were used in combination with daily stream flow and suspended sediment measurements distributed by the U.S. Geological Survey.

These data files were used in two modeling approaches: (1) a downstream-directed analysis; and (2) an upstream directed analysis. The downstream-directed analysis involved the calculation of the concentration profiles for a range of contaminants based on: the estimated quantity of contaminant discharged at specified locations; the flow regime(s) in the river; and the value of the disappearance coefficient. The upstream-directed analysis involves calculating the concentration profile for a contaminant based on: the concentration of the contaminant at a selected downstream point; the flow regime(s) in the river; and the value of the disappearance coefficient. The upstream-directed analysis was used with the Jefferson Parish data to describe estimates of upstream conditions that would be consistent with the observed contaminant concentrations. Both approaches incorporated dilution effects (based on a mass balance technique) and disappearance effects (a first order decay function).

Twelve organic contaminants were used for comparison of simulated concentrations to observed concentrations. These compounds were: dichloromethane, chloroform, carbon tetrachloride, 1,2-dichloroethane, trichloroethene, benzene, toluene, bis(2-ethyl hexyl) phthalate, fluorene, phenol, and nitrobenzene.

Using an assumed disappearance rate at constant streamflow and zero concentration at the upstream study area boundaries with the downstream-directed approach, no known discharges of 1,2-dichloroethane upstream of Baton Rouge were estimated. During a short travel time of 3 days for 130 river miles at average flow, the disappearance rate had relatively little impact on 1,2-dichloroethane concentration. Under low flow conditions, the travel time increased to 5.5 days, which increased the sensitivity of the concentration to the value of the disappearance rate.

Computer generated values compared to actual concentrations measured at Jefferson Parish showed that, with the exception of nitrobenzene, bis (2-ethyl hexyl) phthalate, and toluene, the simulated values reasonably approximate the measured values. The values are closer for average flow conditions. All outputs were presented graphically using the automatic computer plotting and graphic capability of the Routing and Graphical Display System.

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# SECTION I

## INTRODUCTION

Many water utilities in the United States utilize surface waters as the primary source of their drinking water. Several of these utilities are in the process of assessing the water quality of these surface water sources for the purpose of developing water treatment and management strategies and procedures. The ultimate determination of the water quality and water quality variability for these surface water supplies will be based, in many cases, on the results of a water quality monitoring program directed at specifically defining these raw water quality conditions.

The design and implementation of such a water quality monitoring program as well as many other water resource planning strategies must necessarily be based on a knowledge of the type and concentration of pollutants and contaminants that can be reasonably expected to occur in each specific area. In as much as the drainage basin upstream of many of these supplies can encompass many square miles of area and a wide diversity of types and concentrations of economic activity, the potential types and concentrations of pollutants and contaminants in such raw water supplies are almost unlimited. Thus, to correctly focus a water quality monitoring program for example, it is necessary to have some estimate of the pollutants and contaminants that can reasonably be expected to occur in the raw water supply and then to select from that list those pollutants and contaminants that should be monitored by the water quality monitoring program.

Because of the potential for a major expenditure of funds by these utilities in the development of such monitoring programs, the Drinking Water Research Division of USEPA applied a model-based, preliminary screening procedure that with additional information could be used by such utilities confronted with these issues. Important characteristics of such a procedure are the availability of the procedure, its cost and the transferability of the procedure to various parts of the country. Based on these characteristics the Routing and Graphical Display System utilizing the Reach File System and other data bases developed by USEPA was selected as the basis for assessing the feasibility of computer-based modeling and simulation procedures to evaluate the types and concentrations of pollutants and contaminants that might exist in surface water supplies. The manner in which the project was completed and the project results are presented in subsequent sections of this report.

## SECTION II

## PROJECT OVERVIEW

The general purpose of this project was to determine the utility of a model-based technology for screening for the types and concentrations of contaminants that might exist at any point along a stream system. The specific purpose of the project was to conduct this screening process for the lower Mississippi River in the vicinity of the City of New Orleans and to determine the feasibility of further development of the screening process. The Routing and Graphical Display System was selected for use in carrying out the screening process and to demonstrate that this technology could be used for similar purposes at other locations through the United States.

The Routing and Graphical Display System in conjunction with the Reach File System and other data bases developed by USEPA are a modular set of computer-based data files and programs which can be used to route pollutants and contaminants along the stream system represented in one of the data files. At present over 68,000 stream reaches are represented in the data base. The connectivity of these stream reaches has been specified so that it is possible to route flow, pollutants, and contaminants along any stream or stream system that is represented in the data base. Also, available to the Routing and Graphical Display System are data defining the location and types of wastewater discharges (industrial and municipal) to the stream system.

The Routing and Graphical Display System in conjunction with the Reach File System as presently constituted and maintained by USEPA is intended to serve as a management tool that will permit the consistent

analysis of a given water quality issue (such as addressed in this project) on a nationwide basis. Thus, the data base portions of the Reach File System are of necessity, somewhat generalized to provide consistent coverage data for the entire country. However, the Reach File System can be made applicable to location-specific or more detailed problem analysis, provided that the supporting data are available for such a detailed analysis. For purposes of the demonstration project, the Reach File System as maintained by the USEPA was used.

Because water quality monitoring data were available from USEPA for the lower Mississippi River at Jefferson Parish, two types of analyses were performed: a downstream-directed analysis and an upstream-directed analysis. The downstream-directed analysis involved calculating the concentration profile (i.e., the downstream-directed influence line) for a contaminant based on estimates of the quantity of the contaminant discharged at specified locations, the flow regime in the river, and the value of the disappearance coefficeint. The upstream-directed analysis involved calculating the concentration profile (i.e., the upstream-directed influence line) for a contaminant based on the concentration of contaminant at a selected downstream point, the flow regime in the river, and the estimated value of the disappearance coefficient. The disappearance coefficient is a constant for a first-order expression describing the disappearance of a contaminant from the water column by whatever mechanism(s) (chemical, physical, and/or biological) that may be causing the conversion of the contaminant or the extraction of the contaminant from the water column.

The downstream-directed influence lines define the estimated downstream concentrations of a contaminant that can be expected, given the upstream

discharge of known or estimated quantities of the contaminant. The upstream-directed influence lines define the estimated permissible maximum upstream concentrations of a contaminant if a specified concentration at a specified downstream point is not to be exceeded. If the downstream-directed influence line describes higher concentrations than does the upstream-directed influence lines for a specified permissible concentration at a specified downstream point, then the difference between the two lines represents the potential reduction in concentration that must be achieved at any point along the stream if the specified downstream concentration is to be realized. Also, the upstream-directed analysis is useful for estimating the upstream concentrations that would have had to exist in order to produce an observed concentration of a contaminant at a downstream point.

The downstream-directed analysis made it possible to use USEPA estimates of upstream wastewater discharges to estimate downstream-directed influence lines. The upstream-directed analysis made it possible to use the monitoring data to generate upstream-directed influence lines describing estimates of upstream conditions that had to prevail, given a specified disappearance coefficient, to cause the observed contaminant concentrations.

The lack of information regarding the value of the disappearance coefficient for different contaminants is the major shortcoming of the model-based approach to contaminant screening. Thus, the analyses were performed using three different values for the disappearance coefficient, so that the sensitivity of contaminant concentration to the value of the disappearance coefficient value could be conceptually explored.

## SECTION III

## THE ROUTING AND GRAPHICAL DISPLAY SYSTEM

### SYSTEM OVERVIEW

The Routing and Graphical Display System in conjunction with the Reach File System and other data bases developed by USEPA are a modular set of computer based files and programs maintained by USEPA. The relationships among the modules used in the project are illustrated in Figure III-1.

The central component in the Routing and Graphical Display System is the Analytical Reach File (AR File). Information in the AR file is organized by reach: a stretch of river uniquely defined by an upstream and downstream point. The AR File contains both base data on stream reaches such as length, flow, etc., and a description of the connectivity between reaches. Additionally, the AR File can serve as a repository for information generated by analysis programs to be saved for further analysis and display (such as heavy metal concentrations; concentration of organics; etc.).

Other information required for analysis is stored in other data base files: the Industrial Facilities Discharge File (IFD) and the Pollutant Matrix File. The IFD contains discharge and discharger information such as discharge flow, the reach to which flow is discharged, and the industrial category or SIC number of the discharger. Information on both industrial and municipal dischargers is included in the IFD. The Pollutant Matrix file provides information on representative concentrations of selected pollutants under varying treatment conditions for the various industrial discharger categories as stored in the IFD.

Two analysis programs were used to assess the fate and affects of pollutants on the Lower Mississippi River. In the downstream-directed

influence line approach, pollutant loadings, calculated by information stored in the IFD and Pollutant Matrix File, were applied to a stream and the resultant pollutant concentration at any downstream point was calculated through dilution ratios and first order kinetics. In the upstream-directed influence line approach, the user specified an in situ pollutant concentration at any stream point and dilution ratios, and first order kinetics were used to estimate the maximum pollutant concentrations at upstream points. Both programs store the pollutant concentrations estimated for the downstream end of each reach in the AR File for further analysis and/or display.

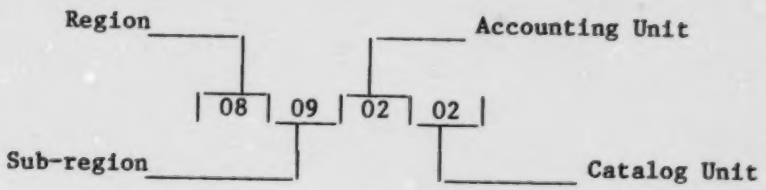
The primary display module utilized in this demonstration project was the profile display software. This software produces computer generated profile (influence line) plots of any information stored in the AR File. For example, a profile of pollutant concentrations along the Mississippi River from Memphis to New Orleans, as calculated by the downstream-directed influence line program, may be produced.

The overall system is designed to encourage the user to iteratively simulate and display a wide-range of alternatives. Utilized in this context, the system can be a powerful planning tool in the area of water resources/ water quality analysis.

HYDROLOGIC STRUCTURE

The Reach File System is based upon a hierarchical hydrologic structure. USGS in conjunction with the U. S. Water Resources Council has defined a system for cataloging hydrologic areas. The contiguous United States is divided into 18 major hydrologic regions based upon river basins. These regions are further subdivided into successively smaller hydrologic

divisions (watersheds) referred to as sub-regions, accounting units, and catalog units. Thus, catalog units, the smallest hydrologic areas, are defined by an 8-digit coding system. The following is an example of this coding system:




The hierarchically defined hydrologic areas for the Lower Mississippi River Basin (Hydrologic Region 8) are presented in Figure III-2. The numbers in bold lettering represent the Region, Sub-region and Accounting Unit. The lower case numbers represent the catalog units.

The representation of streams within the system are imbedded within the hierarchical hydrologic structure. Stretches of river, called "reaches", have been previously defined by USEPA based partially on a set of general rules (i.e., maximum stream length, etc.) and partially on individual judgements of those developing the file, as to which reaches should/should not be included when the general rules could not be applied. Each reach is identified by the hydrologic unit within which it is wholly contained and a unique sequential number within the hydrologic unit. For example:

| 08090202 | | 007 |
|---|---|---|
| Hydrologic Unit | | Unique Sequential Reach Number |

There are approximately 68,000 defined reaches in the United States. Approximately 55,000 reaches are considered as hydraulic transport paths and are stored in the AR File for use in analysis. The remaining reaches include lake shoreline, ocean shoreline, etc., and are maintained only for plotting purposes. An example computer generated plot of the reaches in the Lower Mississippi River Basin is presented in Figure III-3.

DATA FILES

Three types of files maintained by USEPA were used in the demonstration project: the Analytical Reach File (AR File); the Industrial Facilities Discharge File (IFD); and the Pollutant Matrix File.

Analytical Reach File (AR File)

The AR File is organized by hydrologic regions with one file per region. Within each file, a separate logical record containing information on the reach characteristics, the connectivity between reaches, and any temporary information on the reach generated by analysis programs (as referenced earlier) is maintained for each reach.

Permanent information maintained within the AR File for each reach includes:

- length
- hydrologic stream order
- estimated average and low flow
- estimated monthly average flows
- contiguous upstream and downstream reaches
- reach type (free flowing river, estuary, terminal reach, etc.)

The AR File is also utilized to store information on reaches generated by analysis programs for further analysis or display. For example, an

analysis program may generate the concentration of a selected pollutant at the downstream end of each reach. This information can be stored in the AR File and then used in the generation of a plot of a profile of concentrations along a river.

The AR File is designed sequentially by reach number. However, it is designed such that reaches may be accessed in hydrologic order either from upstream to downstream or downstream to upstream, by catalog unit or simply numerically by reach number.

Industrial Facilities Discharge File (IFD)

The IFD file contains information on approximately 52,000 industrial and municipal discharges in the United States. This file was derived from NPDES permit information but is not routinely updated and thus must be used with some caution. Information in the IFD file pertains to both facilities and the individual pipe discharges at the facilities. The types of information available from the IFD files include:

- location (reach number and in some cases the reach location in terms of miles above the downstream end of the reach);
- type of facility (Standard Industrial Category (SIC) and/or the industrial category as defined by the Effluent Guidelines group at EPA); and
- average or permitted flow rate.

Information in the IFD file may be accessed by individual pipes or facilities, or by reach or by higher level hydrologic areas (catalog units).

Pollutant Matrix File

The IFD file does not contain information on the pollutant constituents in the discharges of the facilities. However, a mechanism for estimating such constituents is provided by the Pollutant Matrix File. The Pollutant

Matrix File provides a representative pollutant concentration for selected pollutants by industrial category and general treatment level. Since there is significant variation in actual discharge concentrations, the concentrations provided in this file should be viewed as representative values and used with caution. The 27 industrial categories addressed by the matrix correspond to those stored in the IFD file and include a category for publically owned treatment works (POTW's). Four general treatment levels included in the Pollutant Matrix File are:

- 1972 - General level of treatment prior to PL 92-500.
- Current - General level of treatment currently in use.
- BPT - Best Practical Treatment
- BAT - Best Available Treatment

The Pollutant Matrix File currently contains pollutant concentrations on 10 heavy metals and phenol. However, efforts are currently under study at USEPA to expand this matrix to include a wider range of constituents. Additionally, for the purpose of the present study this file was expanded to include representative discharge concentrations for selected organic pollutants.

ANALYSIS PROGRAMS

Two types of analysis programs are available for estimating the impacts of pollutants on receiving streams: the downstream-directed influence line program; and the upstream-directed influence line program. Both programs utilize the same general modeling techniques, which incorporate both dilution effects and effects of decay (disappearance) of certain constituents. The effect of dilution is estimated by simple mass balance as represented by the equation:

Concentration = Load/Flow

A first-order, exponential decay function, dependent upon travel time, is utilized to estimate disappearance of constituents due to physical, chemical, and biological processes. This disappearance is represented mathematically as:

$$C_{t_1} = C_{t_o} e^{-(t_1 - t_o)/K}$$

where:

$C_{t_1}$ is the concentration of constituent (n) at time $t_1$

$C_{t_o}$ is the initial concentration of constituent (n) at time $t_o$

K is the disappearance coefficient (constant)

The above procedures for estimating dilution and disappearance phenomena is the same as that applied in other commonly accepted water quality models such as QUAL-II.

Downstream-Directed Influence Line Program

The downstream-directed influence line program is a versatile piece of software that permits the user to model pollutant/contaminant levels in the streams/rivers that are present in the Reach File System. The pollutant/contaminant modeling is accomplished through the use of the industrial and municipal discharge data contained in the IFD files and hydrologic data in the Analytical Reach File, along with other factors discussed below, to define the pollutant/contamination concentrations, etc. along the course of a stream/river. The software permits addressing issues on a reach by reach basis as well as providing certain intra-reach simulation capabilities. On the intra-reach basis, pollutant/contaminant disappearance and incremental lateral flows can be simulated in terms of their impact on the level (concentration) of pollutants/contaminants. The interreach simulation capability

makes it possible to route pollutants/contaminants from one reach to another as the reaches are defined in the data base. For simulation purposes, mass and flow balances are accomplished at the upstream end of each reach to account for flow and load changes on a reach-by-reach basis.

A simple example of the procedures used in the downstream-directed influence line program is illustrated in Figure III-4. In this example the flows and loads of reaches 4 and 5 combine at point A to contribute to the flow and loads of reach 3. Within reach 3 there are two discharges; i.e., one at point B and one at point C. It is to be noted that within the IFD file, municipal discharges are represented as a category of industry. For routine purposes reach 3 is subdivided into three subsegments (subreaches) AB, BC, and CD; point D being the downstream terminus of reach 3. For each subsegment the software calculates the time-of-travel within the subsegment and the pollutant/contaminant concentration at the downstream end of the subsegment. These calculations are in part based on the pollutant/contaminant concentration at the upstream end of the subsegment, the rate of disappearance of the pollutant/contaminant, and the lateral inflow per stream unit. The discharges indicated at points B and C within reach 3 (Figure III-4) are assumed to discharge to the upstream end of the downstream subsegment, rather than the downstream end of the upstream segment; i.e., mass and flow balances are done at the upstream end of reaches and subsegments rather than at the downstream end of reaches and subsegments.

The user of the downstream-directed influence line software has a wide-range of options which may be selected when using the software. These options are:

1. Flow Regime - The user may select the average, low or any of the 12 monthly average flows stored in the AR File for use in doing pollutant/contaminant routing. The same category of flow must be used for all reaches.

2. Flow Calculation Index - The user may specify for the purpose of calculating stream flows; no industrial flows, industrial flows from specified industrial categories, or flows from all industrial categories. These flows are added to the stream/river flows stored in the AR File. Note that municipal wastewater discharges are a category of industrial discharges.

3. Pollutant/Contaminant - Any of the eleven pollutants/contaminants presently addressed in the USEPA files may be selected for routing. These pollutants/contaminants are: cadmium, total chromium, trivalent chromium, hexa-valent chromium, copper, cyanide, lead, mercury, nickel, zinc and phenol.

4. Disappearance Rate - A disappearance rate may be specified. If no disappearance rate is specified, the assumed (default) value is zero, meaning a conservative substance is being considered. The units of the disappearance rate are inverse days (1/days).

5. Upstream Background Level - The pollutant/contaminant concentration (in ug/L for the above pollutant/contaminants) for flows entering a study area may be specified. Alternatively concentrations resulting from other routing scenarios or from the use the software for upstream hydrologic regions may be used.

6. Pollutant/Contaminant Concentration in Lateral Flows - The pollutant/contaminant concentrations in the lateral flows to a reach

may be set equal to zero, equal to a user specified constant value, or to a value equal to the concentrations present within the reach.

7. Minimum Flow - For reaches with a natural flow of zero for the flow category being used or where there are not natural flow values in the AR File, due to editing, the minimum flow to be used for routing may be specified. The default value is 0.1 cfs.
8. Industrial Discharge Category - Any or all of the 27 industrial discharge categories may be specified. These are listed in Table III-1.
9. Treatment Category - For each of the 27 industrial discharge categories any of four types of treatment can be specified; i.e., 1972, current, BAT, or BPT. The impact of treatment is determined by industrial discharge category not by specific industrial discharge.
10. Pollutant/Contaminant Removal Level - A multiplier may be selected for each combination of industrial discharge category and treatment category. The default value is 1.0 which means that the value presented in the USEPA matrix of industrial discharge category and treatment category will be used.
11. Study Area - An entire hydrologic region may be specified or an appropriate sequence of up to five catalog units may be specified.

Upstream-Directed Influence Line Program

Where it is desired to infer the upstream concentrations of pollutant from actual in situ water quality data, the Routing and Graphical Display System contains an upstream-directed influence line program. In this analysis program the concentration of a pollutant is fixed at a given value at a specific point in the stream of a network. The program calculates the

profile of maximum concentration at upstream points which result in the fixed concentration downstream by using the same first-order kinetics and flow dilution process used in the downstream-directed influence line program. The resulting curve represents an upper envelope of values that one should expect to observe in situ based on the assumptions made.

A minimal amount of user-specified options are available with the upstream-directed influence line program. The user must select the flow regime and disappearance rate as he would in the downstream-directed influence line program. The user must also specify the concentration of the pollutant at the control (downstream) point. The program will then calculate the pollutant concentration in all reaches upstream in the hydrologic region with the exception of reaches with an assigned flow of zero.

DISPLAY SOFTWARE

The display format selected for the demonstration project was the profile plot. The profile plot graphically represents any information contained in the AR File including data generated by the analysis programs. An example profile plot is shown in Figure III-5. The calculated dependent parameter is plotted as the ordinate and the distance along the river measured from the mouth of the river is plotted as the abscissa. The values are plotted at the downstream end of each reach with the reach numbers noted along the abscissa.

TABLE III- 1

INDUSTRIAL DISCHARGE CATEGORIES USED IN THE

ROUTING AND GRAPHICAL DISPLAY SYSTEM (RGDS)

| RGDS CATEGORY NUMBER | TYPE OF INDUSTRY |
|---|---|
| 1 | Aluminum Forming |
| 2 | Battery Manufacturing |
| 3 | Coal Mining |
| 4 | Coal Coating |
| 5 | Foundries |
| 6 | Inorganic Chemical |
| 7 | Iron and Steel |
| 8 | Leather |
| 9 | Metal Finishing |
| 10 | Non-Ferrous Metals |
| 11 | Ore Mining |
| 12 | Organic Chemicals |
| 13 | Paint |
| 14 | Porcelan |
| 15 | Steam Electric |
| 16 | Publicly-Owned Treatment Works |
| 17 | Copper Forming |
| 18 | Textiles |
| 19 | Timber |
| 20 | Pharmaceuticals |
| 21 | Ink |
| 22 | Pesticides |
| 23 | Petroleum Refining |
| 24 | Pulp and Paper |
| 25 | Laundries |
| 26 | Photo |
| 27 | Electrical |

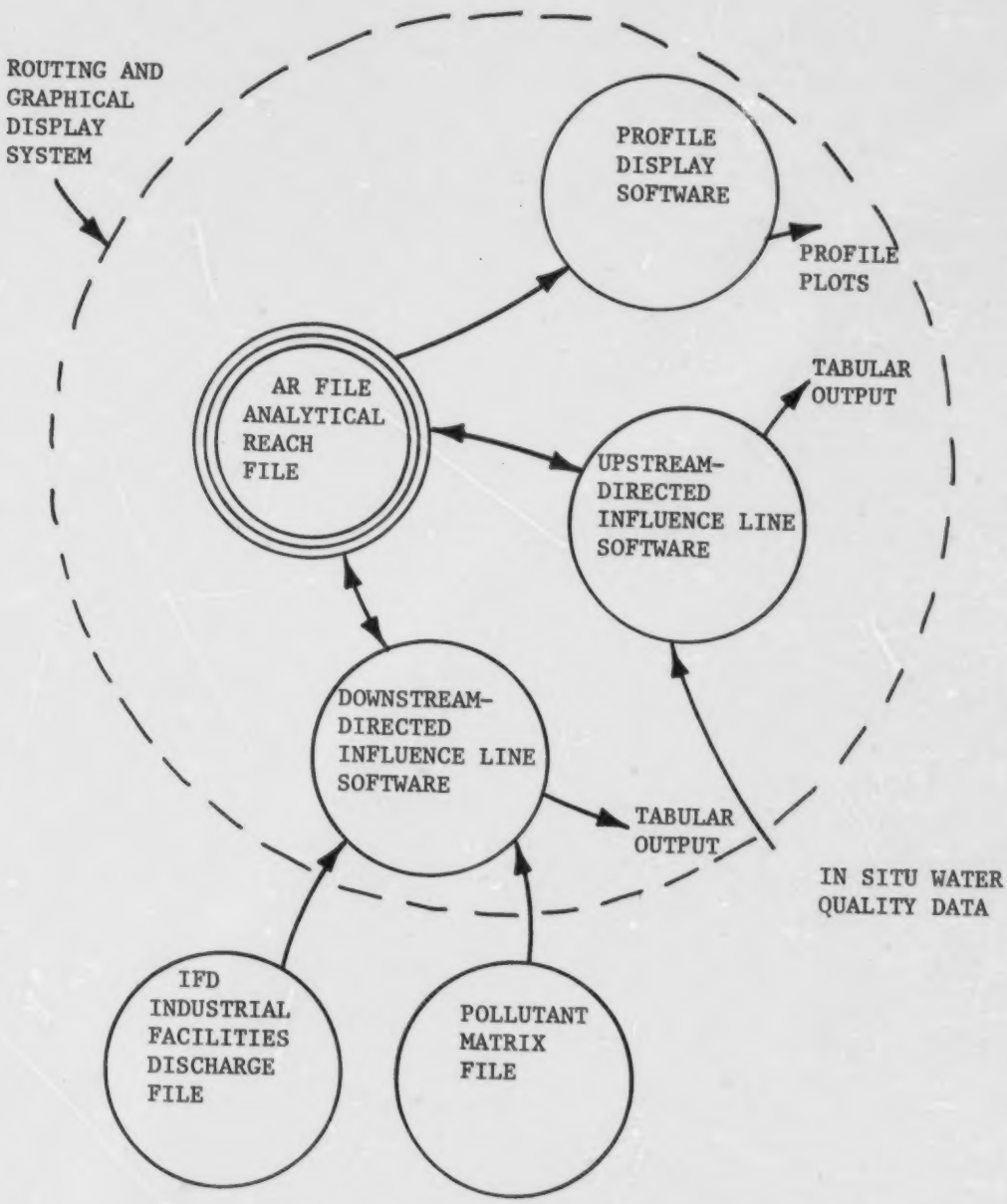



FIGURE III-I

RELATIONSHIP AMONG COMPONENTS OF THE ROUTING AND GRAPHICAL DISPLAY SYSTEM AND OTHER FILES IN THE DEMONSTRATION PROJECT

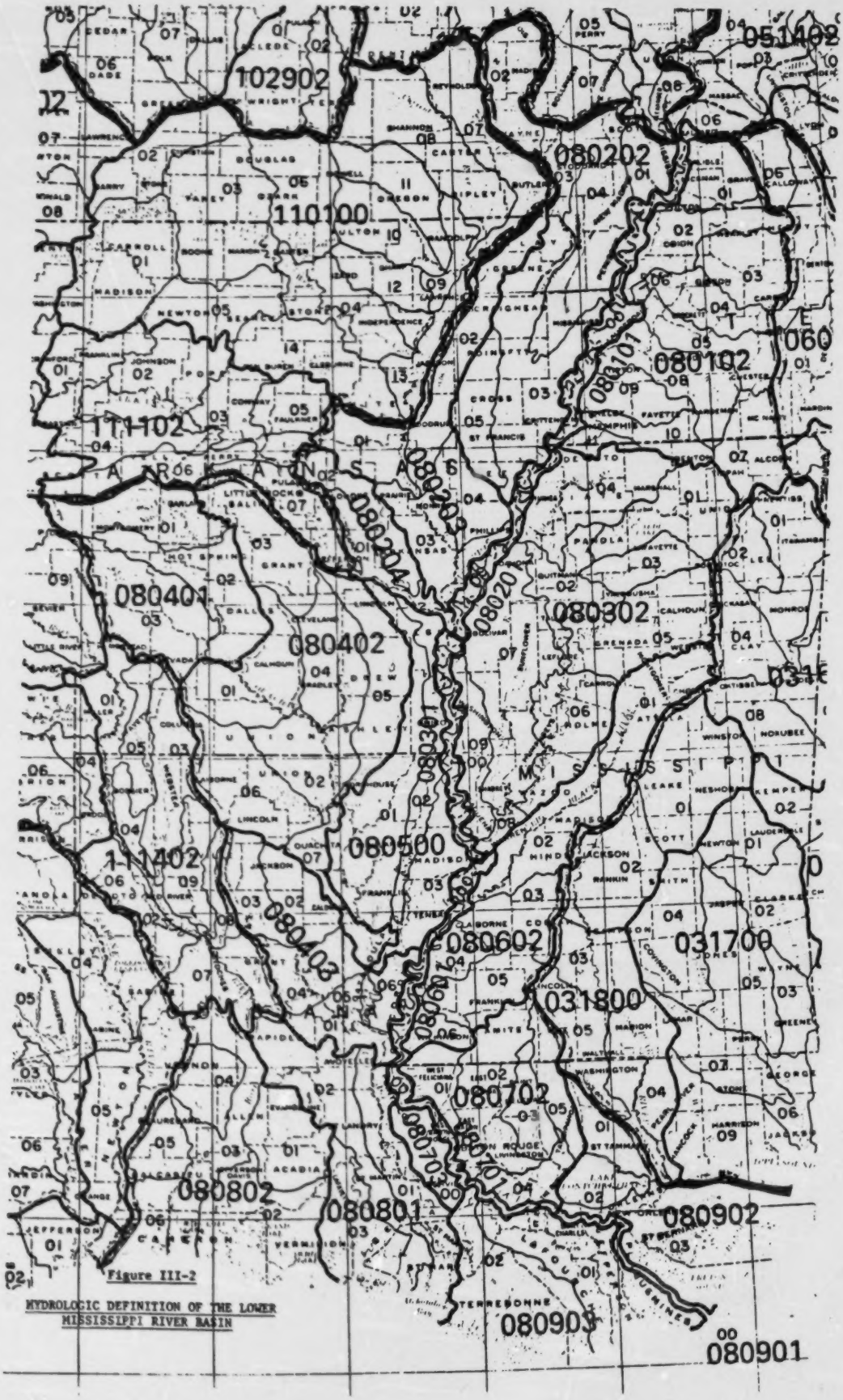



Figure III-2

HYDROLOGIC DEFINITION OF THE LOWER MISSISSIPPI RIVER BASIN

III-10

Figure III-3

EXAMPLE PLOT OF REACHES
IN THE LOWER MISSISSIPPI RIVER

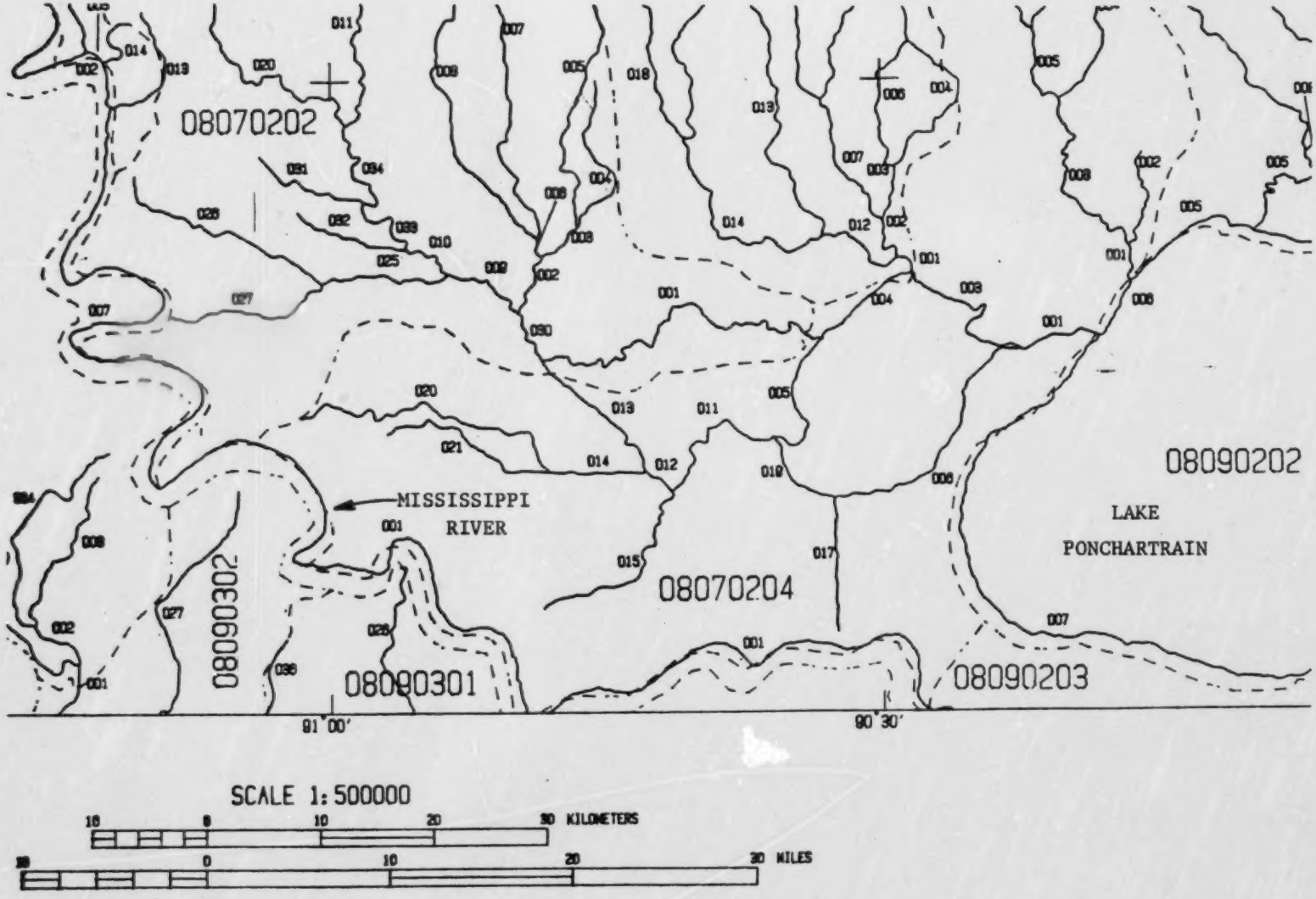
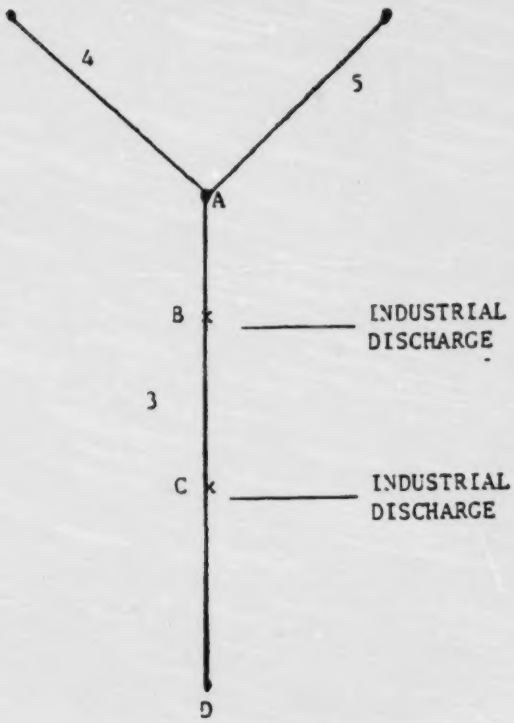


FIGURE III-4

SCHEMATIC OF A SIMPLE ROUTING PROBLEM



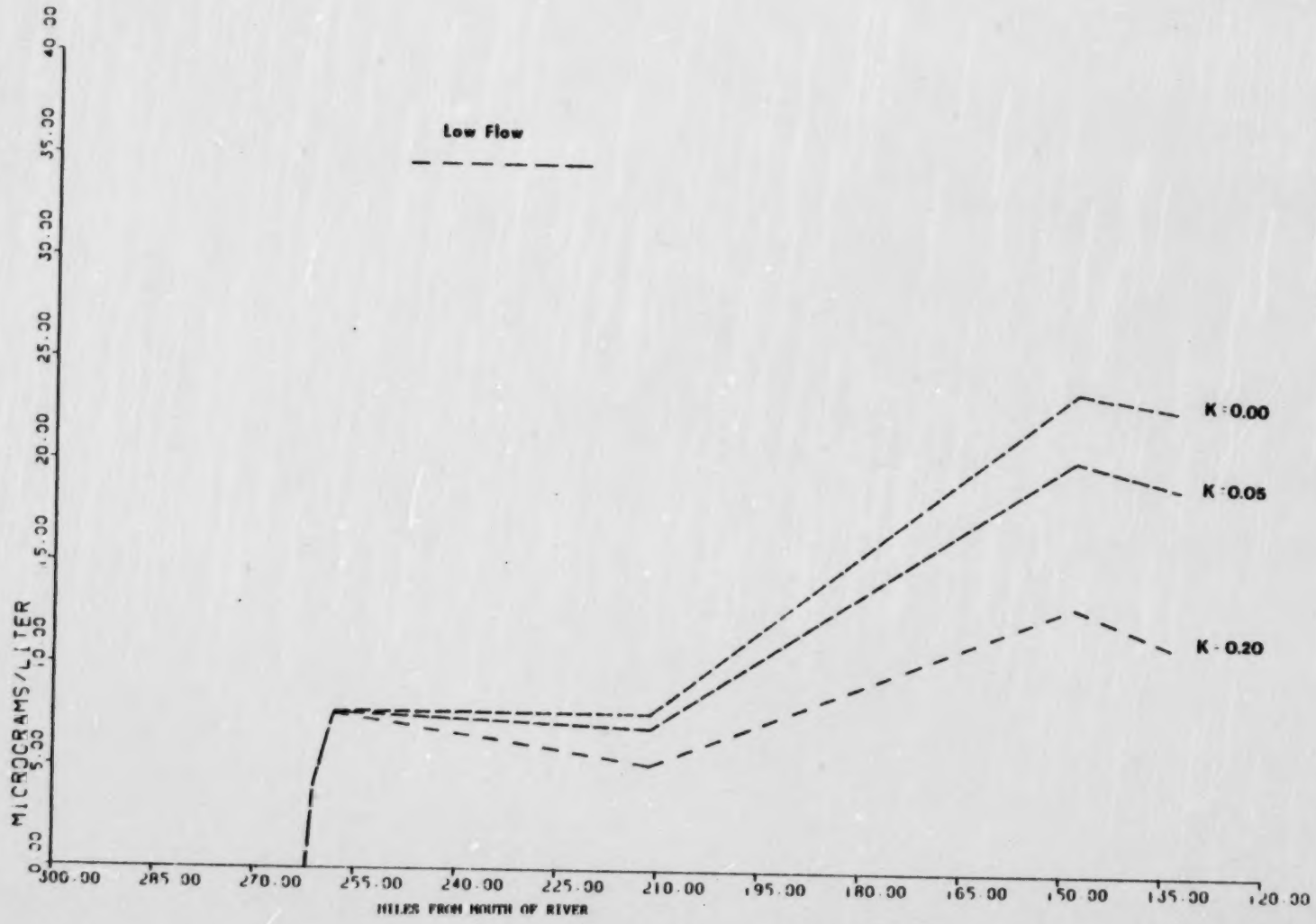



FIGURE III-5. EXAMPLE PROFILE PLOT

## SECTION IV

## PROJECT DATA BASE

### HYDROLOGY

For purposes of this project, USEPA selected Hydrologic Region 8, the Lower Mississippi River Basin as defined by the Water Resource Council. This area, heavily outlined on Figure IV-1, encompasses the mainstream of the Mississippi River from its confluence with the Ohio river to the Gulf of Mexico and all the tributaries in between that are represented in the Reach File System data base.

Hydrologic Region 8 is represented by approximately 1800 reaches or stream segments in the Reach File System data base. The mainstem Mississippi as defined in the Reach File System data base is shown schematically in Figure IV-2 with the river mile locations of all major cities and tributaries.

As illustrated in Figure IV-2, the USGS has maintained a stream gaging station on the Mississippi River at Tarbert Landing, Mississippi since 1973. This gaging station is approximately 200 miles upstream of New Orleans and 8.2 miles downstream of the Old River control structure through which approximately 30 percent of the streamflow is diverted to the Atchafalaya River Basin. Based on the gage data for the period of record (water years 1973-1979), the average flow at this point on the mainstem Mississippi river is approximately 540,000 cfs and the range of flow is 129,000 cfs to 1,500,000 cfs. Additional flow statistics are presented in Table IV-1.

The distribution of daily flows for the period 1977 to 1979 was selected for additional analysis because it corresponds to the period of intensive water quality monitoring at Jefferson Parish by USEPA (see

Section I). The analysis was conducted to determine any correspondence between the variabily of streamflow and the variability of water quality. As illustrated in Figure IV-3, the probability distribution of stream flows in the Lower Mississippi River from 1977 through 1979 is skewed towards lower flows, resulting in a median flow (400,000 cfs) less than the mean flow of 495,000 cfs. More specifically, the 50 percent of flows less than the median value occur in the relatively narrow range between 129,000 cfs to 400,000 cfs while the 50 percent of flows greater than the median value occur in the broader range between 400,000 cfs and 1,420,000 cfs. During the water quality monitoring period, 99% of the observed flows in the Mississippi River occurred in the range of 130,000 cfs to 1,410,000 cfs, a ratio of 11:1.

The velocity, hence time-of-travel, in the Mississippi river is a function of the flows presented/discussed above. Actual dye studies conducted by USGS were used to develop the empirical relationships between flow and time-of-travel stored in the Reach File System data base and used in this project. The relationships for the Mississippi River from the confluence with the Ohio River to New Orleans are illustrated in Figure IV-4 for low flow and average flow conditions. The inverse of the slope of the time-of-travel curves in Figure IV-4 is equivalent to the velocity of either average or low flow and is equal to 2.6 fps and 1.5 fps, respectively. These functional relationships compare quite favorably with actual time-of-travel studies conducted by the USGS between Baton Rouge and New Orleans, wherein observed flow of 240,000 cfs yields a velocity of approximately 2.0 fps and a flow of 1,000,000 cfs (more than twice the average flow) yielded a velocity of 4.5 fps.

## WATER QUALITY

Water quality data for the Lower Mississippi River is extensive and available from numerous governmental agenices. For purposes of this project is was necessary to select a subset of this data base which related to the general area of New Orleans, contained information on a wide-range of potentially toxic substances, and could be related to known streamflow conditions. Such a data base was available from a study of organic contaminants conducted by USEPA between 1977 and 1979. During this period, USEPA monitored the raw water intake and treatment processess of a granular activated carbon (GAC) pilot treatment facility at the Jefferson Parish Water treatment plant just upstream of New Orleans (Reference IV-1). Analyses included:

- non-specific organics
- volatile organics
- semi-volatile organics
- physical and chemical constituents
- microbiological parameters

A list of specific contaminants is presented in Appendix A. The focal point of this study was the removal of contaminants in raw water through application of GAC technology; thus no statistical or comparative analyses of the raw water data base to evaluate in-stream water quality conditions were undertaken. Viewing the raw water data base as a valuable resource to understand the interrelationships between the discharge of potentially toxic substances and receiving water quality, the raw water data was examined before applying it to this project. To this end, the raw water data at Jefferson Parish was supplemented by associated stream flow and suspended sediment data in order to assess the variability of contaminant

concentrations and loads, the potential relationships between streamflow and contaminant concentrations and loads, and the possible interdependencies between contaminant levels and levels of suspended solids in the Mississippi River caused by toxic ladened solids. This supplemental data base was derived by associating the Jefferson Parish data with the daily streamflow and suspended solid measurements taken by the USGS at Tarbert Landing and transposing the latter by six days, the assumed travel time between Tarbert Landing and Jefferson Parish.

Several statistical analyses were performed on the supplemental data base. These included calculation of:

- the mean and standard deviation of the contaminant concentration and loading (lbs/day) to determine average values and the variability around the average concentrations/loads;
- correlation between contaminant concentrations/loads and stream flow to infer the nature of discharges to the River and the impact of streamflow thereon;
- correlation between contaminant concentration/load and sediment concentration/load to assess the possibility of sediment serving as a reservoir and transport mechanism for pollutants;
- correlation between sediment concentration/load and flow to determine the character of sediment loadings and the impact on these loadings caused by streamflow.

A small program was written to merge/transpose the required data bases and perform the necessary calculations and products, but a detailed analysis of this data base was beyond the scope of this project. The output is presented in its entirety in Appendix B, and has been retained on computer tape to facilitate any future analyses.

Several interesting observations were noted within the framework of the analysis objectives discussed above.

- The variability in the concentration and loading of most contaminants is great leading to the presumption that both streamflow influences pollutant concentrations, and the discharge of the mass of contaminants varies greatly.
- Based on the lack of correlation between streamflow and contaminant concentration/load for most contaminants, there is very little relationship between flow in the river and the presence of contaminants.
- A few contaminants appeared to be strongly negatively correlated to streamflow (i.e., as streamflow increases, contaminant/concentration decreases). This suggests that the contaminant mass discharged is reasonably constant. An example of this negative correlation is illustrated in Figure IV-5 where the concentration of chloroform decreases as streamflow increases.
- There appears to be a strong positive correlation between streamflow and contaminant concentration for a few contaminants. This is not as easy to interpret but may be caused by increased discharges of contaminants at higher flows including contaminants contained in runoff or groundwater inflow.
- There appears to be very little correlation between the concentration of contaminants and suspended solids. This is interpreted to mean that sediments do not appear to act as a significant reservoir or transport mechanism for the contaminants (assuming the analytical procedures extract contaminants attached to the sediments). A few

contaminants are negatively correlated to suspended solids concentration; however, these may be spurious correlations given the apparent lack of correlation between flow and contaminant concentration and the strong correlation existing between streamflow and suspended solids. This is to be expected given the severe erosion problems of the central United States.

USEPA expressed an interest in the 11 contaminants listed in Table IV-2 because they were consistently present in water quality samples and because there is relatively more known about the character of upstream discharges of these contaminants. The mean and standard deviation of these contaminants are presented in Table IV-2 together with the concentrations defining the lower and upper 10 percent of the distribution of values (i.e., limits within which 80 percent of values were observed). For example, 10 percent of the instantaneous chloroform observations were below 200 ng/L (nanograms per liter = $10^{-9}$ grams/liter) and 10 percent were above 1660 ng/L and thus 80 percent were between 200 ng/L and 1660 ng/L.

The probability distributions of contaminant concentrations for the 11 contaminants are presented in Figure IV-6. The high degree of variability in the distributions is evident from the steep slopes, even when plotted on log normal paper. Each distribution is also skewed which produces a difference between the mean value (Table IV-2) and the median value (concentration at 50 percentile).

It is evident from the data presented in Table IV-2 and Figure IV-6 that there is a high degree of variability in the concentration and loading of the 11 contaminants. Quantitative expression of this variability is difficult because of the large number of measurements which are below the

detectable limits of the analytical methods. These measurements are expressed as zero concentration in the data base. Additionally, some variability in concentration may be attributed to the presence of certain pollutants in the anlaysis blanks reported by Jefferson Parish. For example, two of the organic compounds studies in this analysis, dichloromethane and Bis(2-Ethyl Hexyl) phthalate were observed in the analysis blanks by Jefferson Parish on numerous occasions thus producing some erratic results. However, the ratio of maximum concentration to minimum non-zero concentration ranged from 50:1 to 1000:1. These variation in contaminant concentration are much higher than the similar measure (11:1) of streamflows for the period. This high variability in contaminant concentrations relative to steamsflows leads one to suspect that there is a high degree of variability in the mass of pollutants being discharged to the Lower Mississippi River. This is supported by the large standard deviations in total loadings presented in Table IV-2. This variability is important when comparing the results of this project to the USEPA data base (see Section V). Additionally, it points to an area (discharge characteristics) which can/should be refined in subsequent applications of the technology presented herein.

## REFERENCES

IV-1. W. E. Koffskey and N. V. Brodtmann, "Organic Contaminant Removal in Lower Mississippi River Drinking Water by Granular Activated Carbon Adsorption", USEPA, MERL, Cincinnati, Ohio, 1983

TABLE IV-1

FLOW STATISTICS FOR THE MISSISSIPPI RIVER AT TARBERT LANDING, MISSISSIPPI

| | BASED ON 3 YEARS OF RECORD 1977-1979[1] | BASED ON PERIOD OF RECORD 7 YEARS 1973-1979 | BASED ON INTERMITTENT MEASUREMENTS 1936-1979 |
|---|---|---|---|
| | Flow, cfs | Flow, cfs | Flow, cfs |
| MEAN | 495,300 | 543,100 | NA |
| MEDIAN | 400,000 | NA | NA |
| MINIMUM | 129,000 | 129,000 | 85,000 |
| MAXIMUM | 1,420,000 | 1,500,000 | 1,980,000 |

NA = Not Available

1. Period of water quality monitoring by USEPA at Jefferson Parish.

TABLE IV-2

STATISTICAL CHARACTERISTICS OF SELECTED POLLUTANTS

IN THE MISSISSIPPI RIVER AT JEFFERSON PARISH

| POLL. NO. | POLLUTANT | NO. OF SAMPLES | CONCENTRATION ng/L ($10^{-9}$ grams/liter) | | | | Load Thousand Pounds/Day | |
|---|---|---|---|---|---|---|---|---|
| | | | AVERAGE | STANDARD DEVIATION | LOWER 10% | UPPER 10% | AVERAGE | STANDARD DEVIATIO |
| 47 | Dichloromethane | 209 | 712 | 1824 | 0 | 1900 | 1.34 | 3.17 |
| 7 | Chloroform | 209 | 800 | 633 | 200 | 1660 | 1.80 | 1.54 |
| 43 | Carbon Tetrachloride | 209 | 248 | 1006 | 0 | 250 | 0.50 | 1.63 |
| 23 | 1,2 Dichloro-ethane | 209 | 3585 | 4889 | 480 | 8600 | 7.30 | 8.46 |
| 35 | Trichloroethene | 209 | 188 | 396 | 0 | 390 | 0.53 | 1.47 |
| 126 | Tetrachloroethene | 156 | 74.6 | 170 | 0 | 140 | 0.20 | 0.52 |
| 27 | Benzene | 103 | 229 | 526 | 0 | 720 | 0.56 | 1.25 |
| 31 | Toluene | 103 | 45.5 | 100 | 0 | 210 | 0.11 | 0.29 |
| 91 | Bis (2-Ethyl Hexyl) Phthalate | 306 | 16.8 | 97 | 1.1 | 18.7 | 0.05 | 0.29 |
| 104 | Fluroene | 263 | 1.72 | 4.6 | 0 | 4.8 | 0.006 | 0.018 |
| 98 | Nibrobenzene | 263 | 28.2 | 37.7 | 0 | 70 | 0.06 | 0.17 |

FIGURE IV-1

HYDROLOGIC REGION 8
THE LOWER MISSISSIPPI RIVER BASIN

FIGURE IV-2

SCHEMATIC REPRESENTATION OF LOWER MISSISSIPPI RIVER

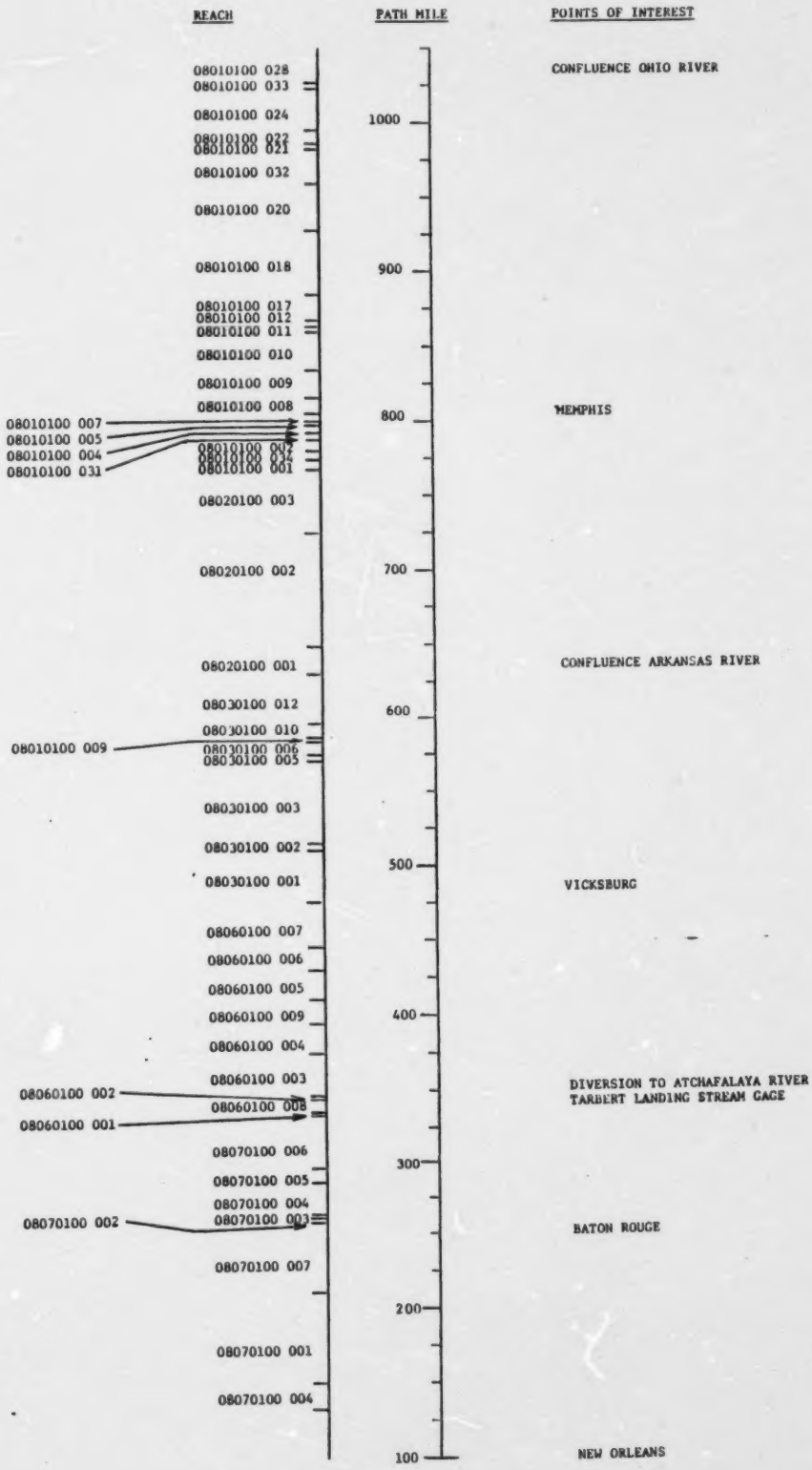


FIGURE IV-3

PROBABILITY DISTRIBUTION OF STREAMFLOW IN
MISSISSIPPI RIVER AT TARBERT LANDING
FROM 1977 TO 1979

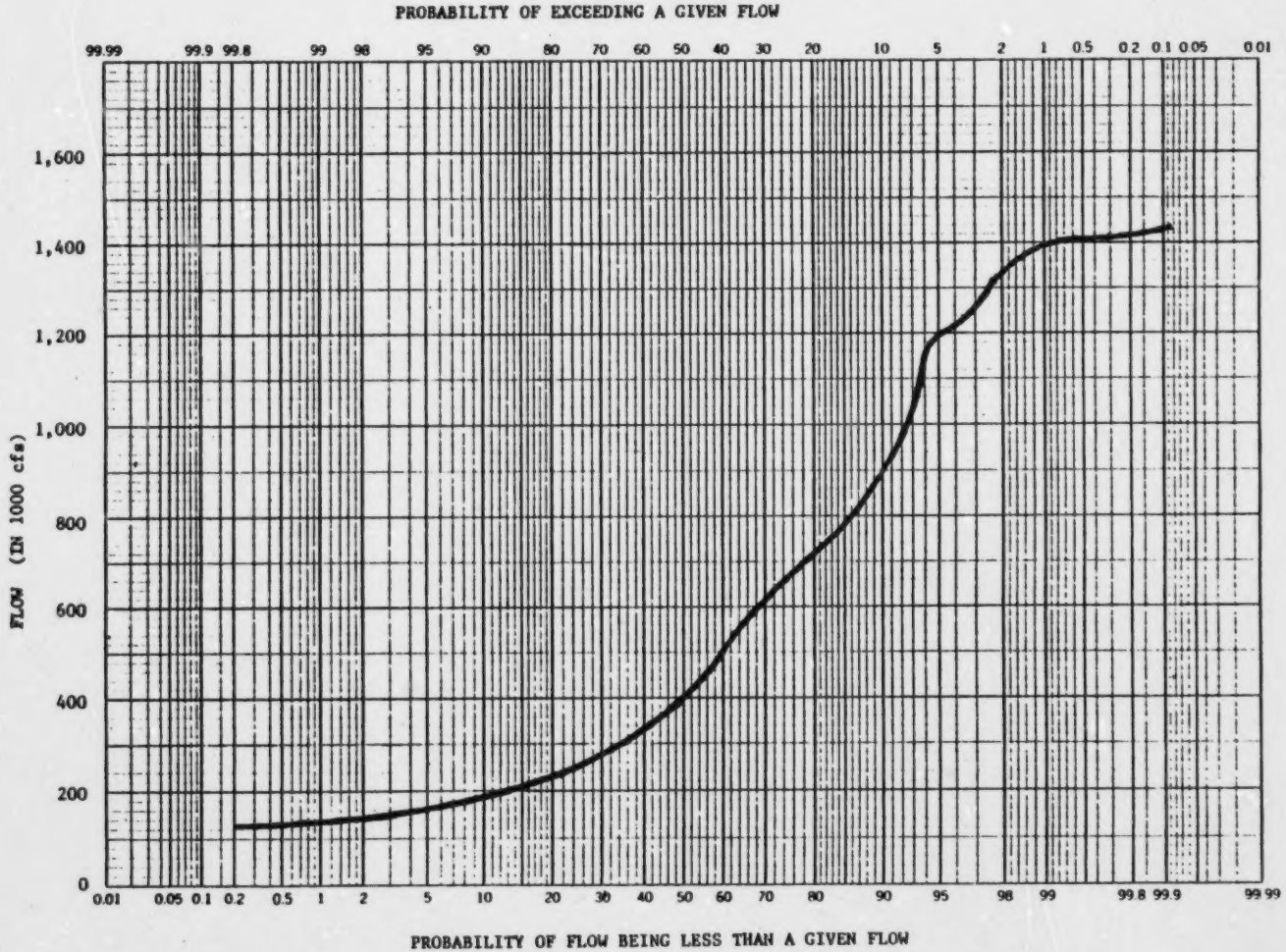


FIGURE IV-4

STREAMFLOW AND TIME-OF-TRAVEL RELATIONSHIPS
FOR THE LOWER MISSISSIPPI RIVER CONTAINED IN THE REACH FILE

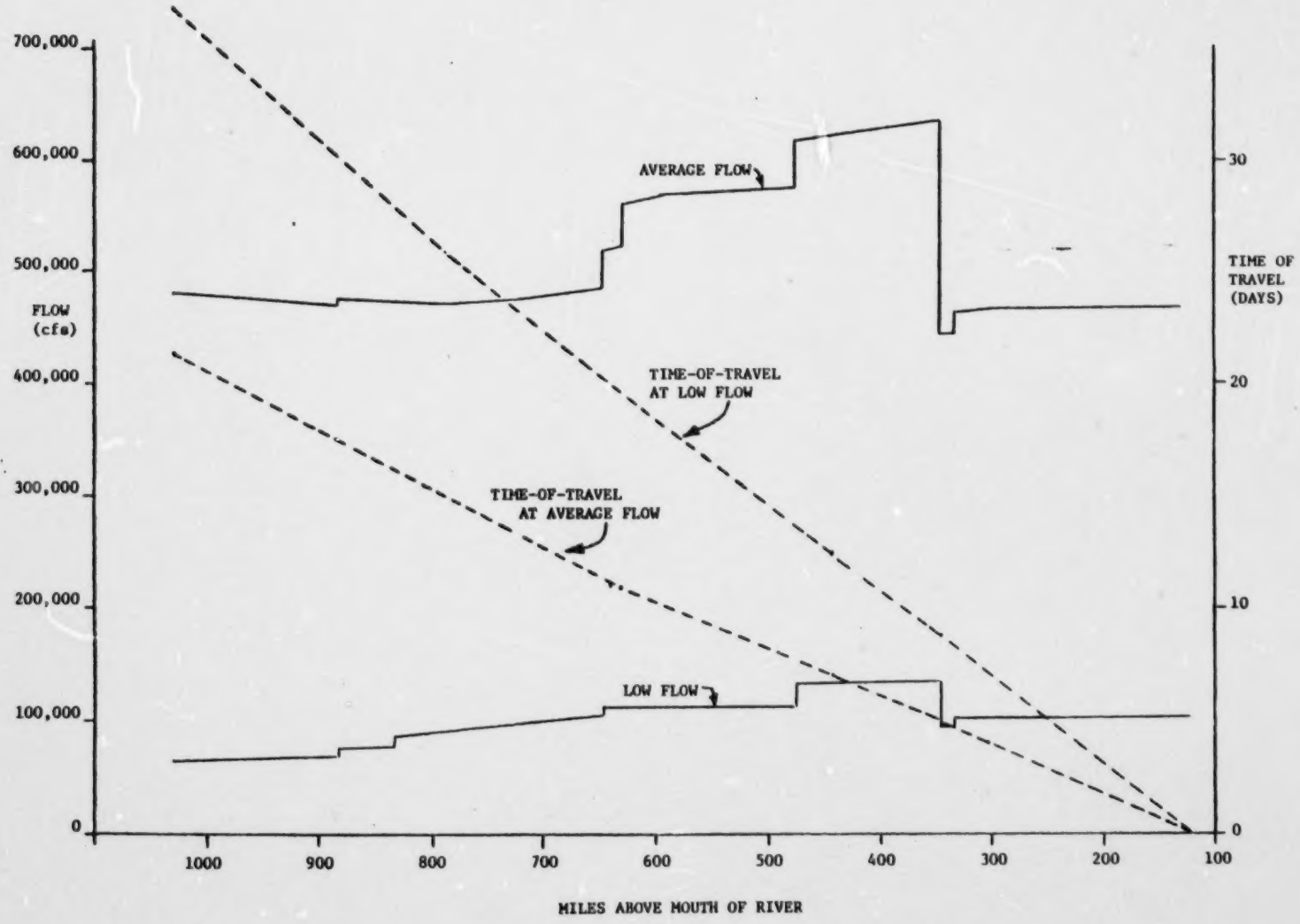


FIGURE IV-5

RELATIONSHIP BETWEEN
CHLOROFORM CONCENTRATION AND STREAMFLOW

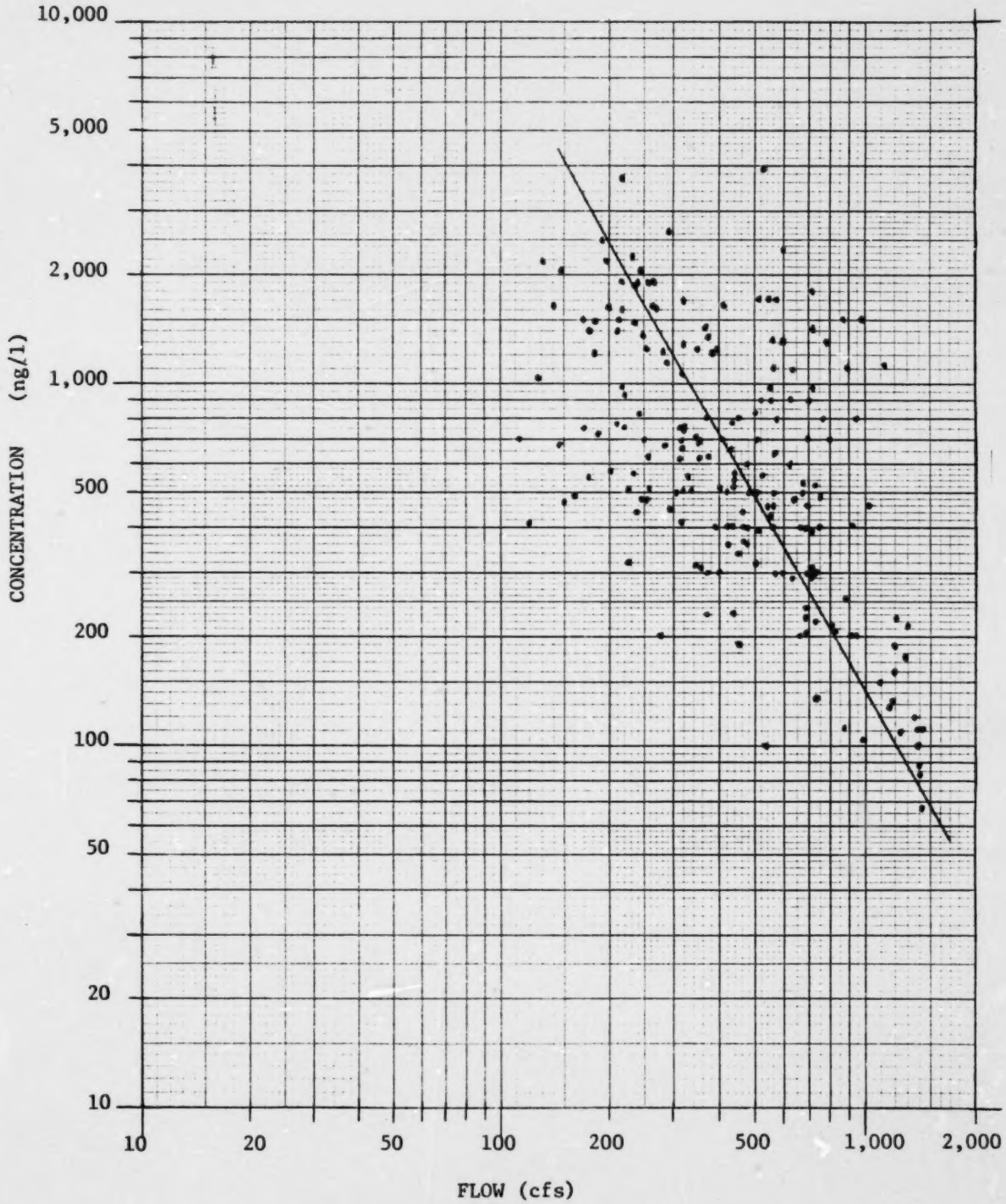
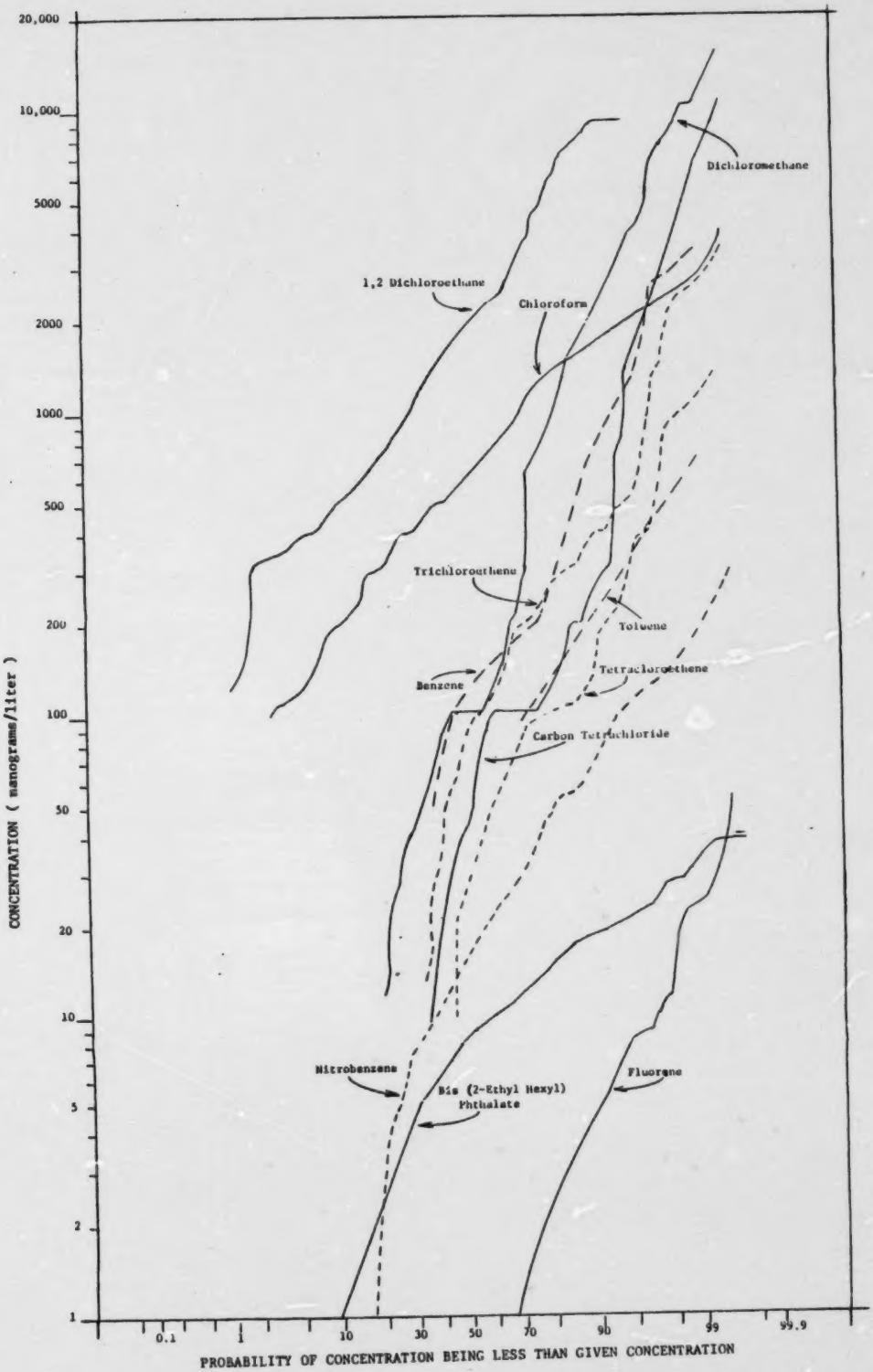


FIGURE IV-6

DISTRIBUTION OF SELECTED POLLUTANTS



## SECTION V

## TECHNOLOGY APPLICATION AND RESULTS

### INTRODUCTION

USEPA's Routing and Graphical Display System was applied to the Lower Mississippi River to demonstrate the use of a model-based technology in estimating the fate and effect of toxic contaminants discharged to the River upstream of New Orleans. Use was made of existing discharge loading information contained in the data base supplemented by more recent information supplied by USEPA to generate downstream-directed influence lines of contaminant concentration. The resulting profiles were compared to the actual in situ water quality data collected by USEPA to determine the appropriateness of the assumptions employed. The in situ water quality data was also used to generate upstream-directed influence lines of contaminant concentrations. The resulting profiles form the envelope of maximum contaminant concentrations upstream of the water quality sampling station under the assumptions made.

### TECHNOLOGY APPLICATION

The application of the Routing and Graphical Display System to generate downstream-directed influence lines utilizes the routing process of the System (see explanation of Analyses Procedures in Section III of this report). The two principal components affecting the routing process are the contaminants discharged to the river and the stream mechanics which affect the transport and transformation of the contaminants within the river. Although contaminant discharges are not directly considered in generating upstream-directed influence lines, the same stream mechanics are applied.

The IFD file was searched for industrial and municipal wastewater facilities discharging to the Lower Mississippi River (Hydrologic Region 8). The IFD provides data on the type of discharge and average flow rate but the file does not contain pollutant loading data.

To address this deficiency a list of dischargers on the mainstem of the Mississippi River in Hydrologic Region 8 was submitted to the Water Quality Analysis Branch of UESEPA. This list included all dischargers contained within the IFD except those discharging only cooling water. Based on this list, USEPA divided dischargers into three groups and provided pollutant/contaminant matrices that could be utilized to estimate discharge characteristics for each group. These groups are:

- Group A - Separate pollutant/contaminant concentration matrices for seven organic chemical plants based on actual production/processes at various treatment technology levels.
- Group B - A single pollutant/contaminant concentration matrix generally applicable to other organic chemical facilities based on industry-wide, flow-weighted, average concentrations. Sixteen industries on the Mississippi River were identified by USEPA within this group.
- Group C - A matrix, current as of February 18, 1983, which, for a limited number of pollutants/contaminants, identifies industry-wide, flow-weighted, average concentrations at various treatment technology levels. This matrix was applied to all other industrial and municipal discharges in the Lower Mississippi River Basin.

The routing program utilizes a first order disappearance function to simulate the various natural processes affecting the concentration of pollutants within the stream. Such processes include volatilization, chemical reactions, absorption, settling, etc. In a first order disappearance function, the rate of change of concentration with time is proportional to the concentration present at any time. The velocity of the stream, which impacts the time the pollutant is present within a stretch of river and, thus, the amount of disappearance that will take place, is estimated by the routing program based on hydrologic stream order and streamflow quantity.

The downstream-directed influence line approach was applied for 12 different contaminants at two different streamflow regimes for three assumed disappearance rates. The contaminants were selected on the basis of the in situ water quality data base at Jefferson Parish and the availability of discharger data in the three pollutant/contaminant loading matrices. The contaminants selected were:

- Dichloromethane
- Chloroform
- Carbon Tetrachloride (Tetrachloromethane)
- 1,2 Dichloroethane
- Trichloroethene (Trichloroethylene)
- Tetrachloroethene (Tetrachloroethylene)
- Benzene
- Toluene
- Bis (2-Ethyl Hexyl) Phthalate
- Fluorene
- Phenol
- Nitrobenzene

The flow regimes used for the analyses were average streamflow and "low" streamflow as contained in the Reach File System data base. "Low" flow as defined in the File is an estimate of the minimum weekly flow that is expected to occur once every 10 years; i.e., the 7 day - 10 year low flow. The three assumed disappearance rates coefficients were 0, 0.05, and 0.2 days $^{-1}$. A value of zero was selected to demonstrate the effect of a conservative contaminant. The disappearance rate coefficient of 0.2 days $^{-1}$ results in a half-life of approximately 3-1/2 days which corresponds to the upper end of decay rates (Reference V-1) and was selected to demonstrate the effect of rapidly decaying contaminants. In all cases, the concentration of pollutants in water flowing into the study area bounderies was assumed to be zero.

The upstream-directed influence line approach was applied under the same streamflow and decay characteristics assumed for the downstream-directed infl ence line approach. The in situ concentration was fixed at 10 ug/L, as an example, at the end of the reach immediately upstream of New Orleans for all flow and decay conditions.

RESULTS

The contaminant profiles resulting from the application of the downstream-directed influence line approach are presented in Appendix C, by contaminant. Comparative profiles based on varying flow and decay rates are presented in Figures V-1 to V-7.

The impact of the assumed disappearance rate at constant streamflow is illustrated in Figure V-1 and V-2 for Dichloroethane. As illustrated, there are no known discharges of Dichloroethane upstream of river mile 263 (just upstream of Baton Rouge) within Hydrologic Region 8, resulting in a concentration of zero above this mile point. At average flow the travel

time for the entire 130 mile length of river shown in Figure V-1 is less than three days. During this short period of time, the disappearance rate has relatively little impact on contaminant concentrations. The travel time increases to 5-1/2 days under low flow conditions, which, as illustrated in Figure V-2, increases the sensitivity of the contaminant concentration to the value of the disappearance rate.

The quantity of streamflow generates two conflicting impacts on the contaminant concentration profiles. Higher flows provide greater dilution capacity and result in lower contaminant concentrations. However, higher flows produce increased velocity and a concomitant reduction in residence time, which results in less disappearance and higher relative pollutant concentrations for an assumed disappearance coefficient. This phenomenon is more significant under high disappearance coefficients. These counteracting effects are illustrated in Figures V-3 and V-4 for Dichloroethane and Benzene. At a disappearance rate of zero, the resulting profiles reflect only the increased dilution effect of higher flows. At river mile 140 the ratio of Dichloroethane concentration at low flow to average flow is approximately 4.5:1 (Figure V-3), and the ratio of Benzene concentration is 4.4:1 (Figure V-4). At a disappearance rate of 0.2 days $^{-1}$, the counteracting impact of decreased residence time results in a concentration ratio (low flow: average flow) of approximately 3:1 for Dichloroethane and 3.2:1 for Benzene.

The effect of upstream discharges is illustrated in Figures V-5, V-6, and V-7, in which the resulting profiles are plotted for all 12 selected pollutants under the same flow (average) and decay (k=0) conditions. Although the wide-range in absolute values of pollutant concentrations tend

to indicate a diversity in discharge loadings of the 12 pollutants (e.g., there is significantly more dichloroethane discharged to the Mississippi River than Fluorene) the similarity in the shape of the concentration profiles indicates a strong correlation between loading characteristics among contaminants. This may be more a manifestiation of the contaminant loading matrices utilized than actual conditions.

Comparison of Results

In order to assess the realiability and accuracy of the model and the assumptions employed, simulated concentrations of 12 contaminants were compared to values recorded at Jefferson Parish.

Selection of 12 contaminants for which actual in situ concentrations exist in the Jefferson Parish data base permitted a comparison between the simulated contaminant concentrations and actual values. The simulated concentrations and actual in situ values at Jefferson Parish are presented in Table V-1. The range and average of contaminant concentrations observed at Jefferson Parish are illustrated as bars in Figure V-8. Simulated concentrations for the two flows and three disappearance rates form Table IV are superimpposed on the bars in Figure V-8. Where the superimposed number (simulated values) fall within the bars (range of actual values), the simulation can be said to reasonably represent observed conditions.

With the exception of Nitrobenzene, Bis (2-Ethyl Hexyl) Phthalate, and Toluene, the simulated values reasonably approximate the range of in situ concentrations. The correspondence is best at average flow while the simulated concentrations at low flow exceed the range of actual values for some contaminants (e.g., Benzene). This might be expected because actual streamflows during the monitoring program were never as low as the low flow

used for simulation. An anomaly is apparent for Carbon Tetrachloride wherein the low flow simulated values are within the range of actual values but the average flow concentrations are not. This could be indicative of an "under loading" of Carbon Tetrachloride in the simulation compared to actual quantities discharged to the river.

The results of the upstream-directed influence line approach for a 10 ug/L contaminant concentration at Jefferson Parish are illustrated in Figures V-9 and V-10. Figure V-9 illustrates the impact of the decay rate from Baton Rouge to New Orleans. The flow representations for both average and low flow are constant within this length of river; thus, there is no change in dilution capacity illustrated in Figure V-9. The concentration profiles in Figure V-9 are a result of varying disappearance rates and the effect of differences in travel times between low and average flow. As discussed previously, the greatest difference in concentrations between average and low flow occur at the highest disappearance rate. In this reach, average and low flow concentrations at K=0 are the same.

This same phenomenon is observable in Figure V-10 where upstream-directed influence lines are plotted for the Lower Mississippi River between the Ohio River and New Orleans. Viewing the 900 miles of river illustrated in Figure V-10, the importance of the disappearance rate and contaminant loadings is readily apparent. As the disappearance rate decreases, the effect of more distant contaminant loading increases. Taken in the extreme, at a disappearance rate of zero (conservative contaminant) a contaminant discharged into the Missouri River in Montana has the same impact on water quality at New Orleans as does a contaminant discharged at Baton Rouge.

## REFERENCES

V-1. USEPA, "Aquatic Fate Process Data for Organic Priority Pollutants", Final Draft Report, 1981.

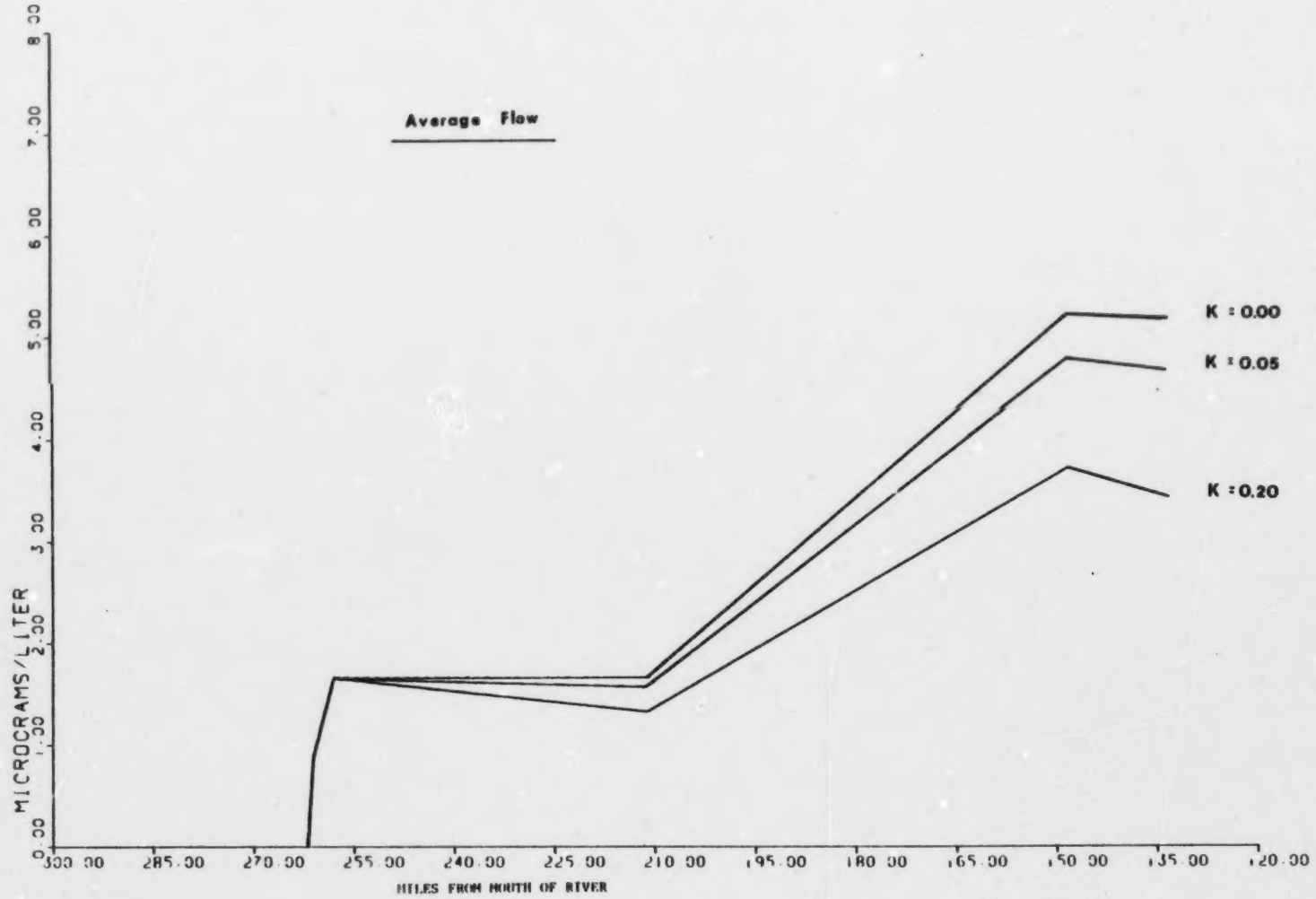



FIGURE V-1. EFFECT OF DISAPPEARANCE RATE(K) ON DICHLOROETHANE CONCENTRATIONS AT AVERAGE FLOW

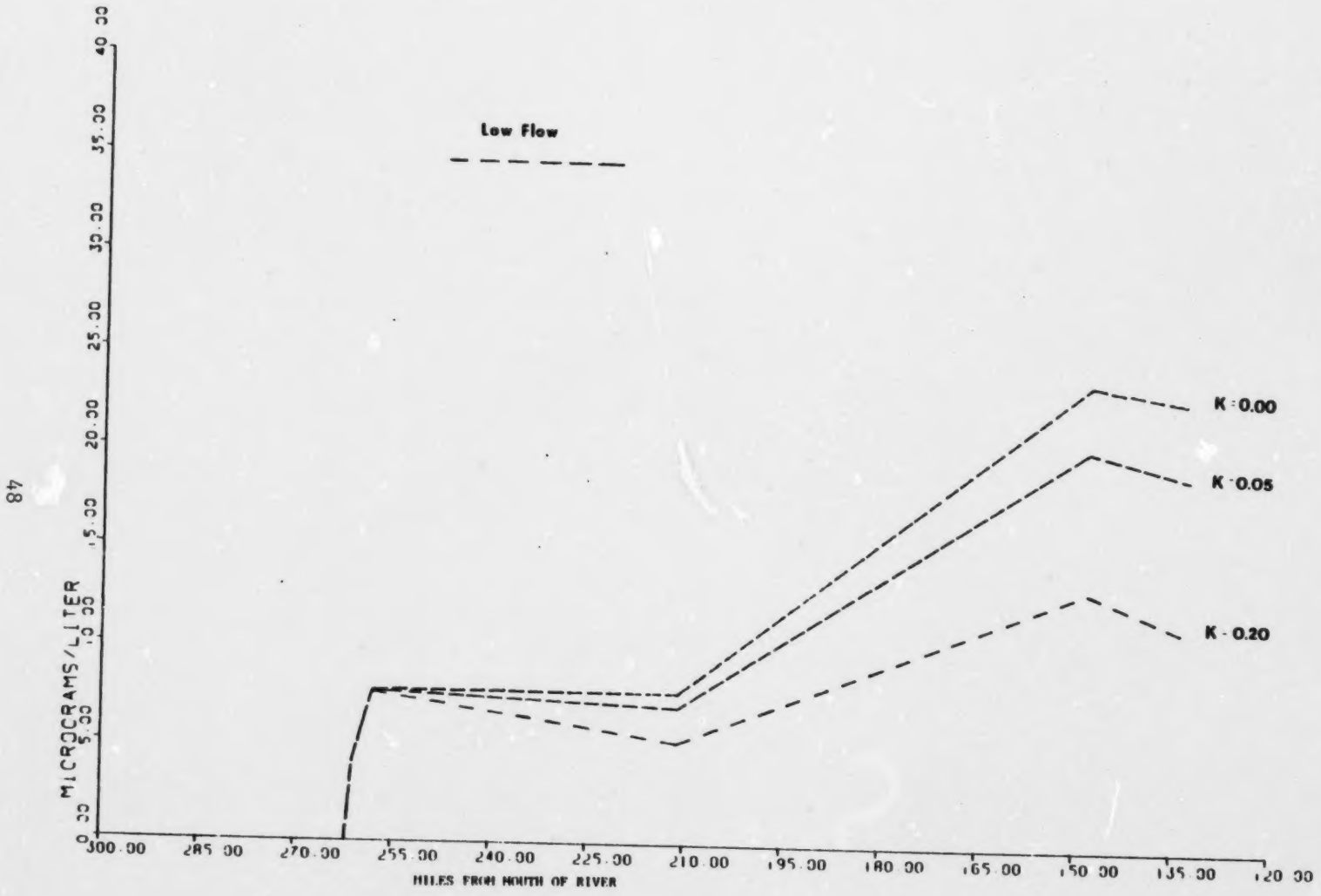



FIGURE V-2. EFFECT OF DISAPPEARANCE RATE(K) ON DICHLOROETHANE CONCENTRATIONS AT LOW FLOW

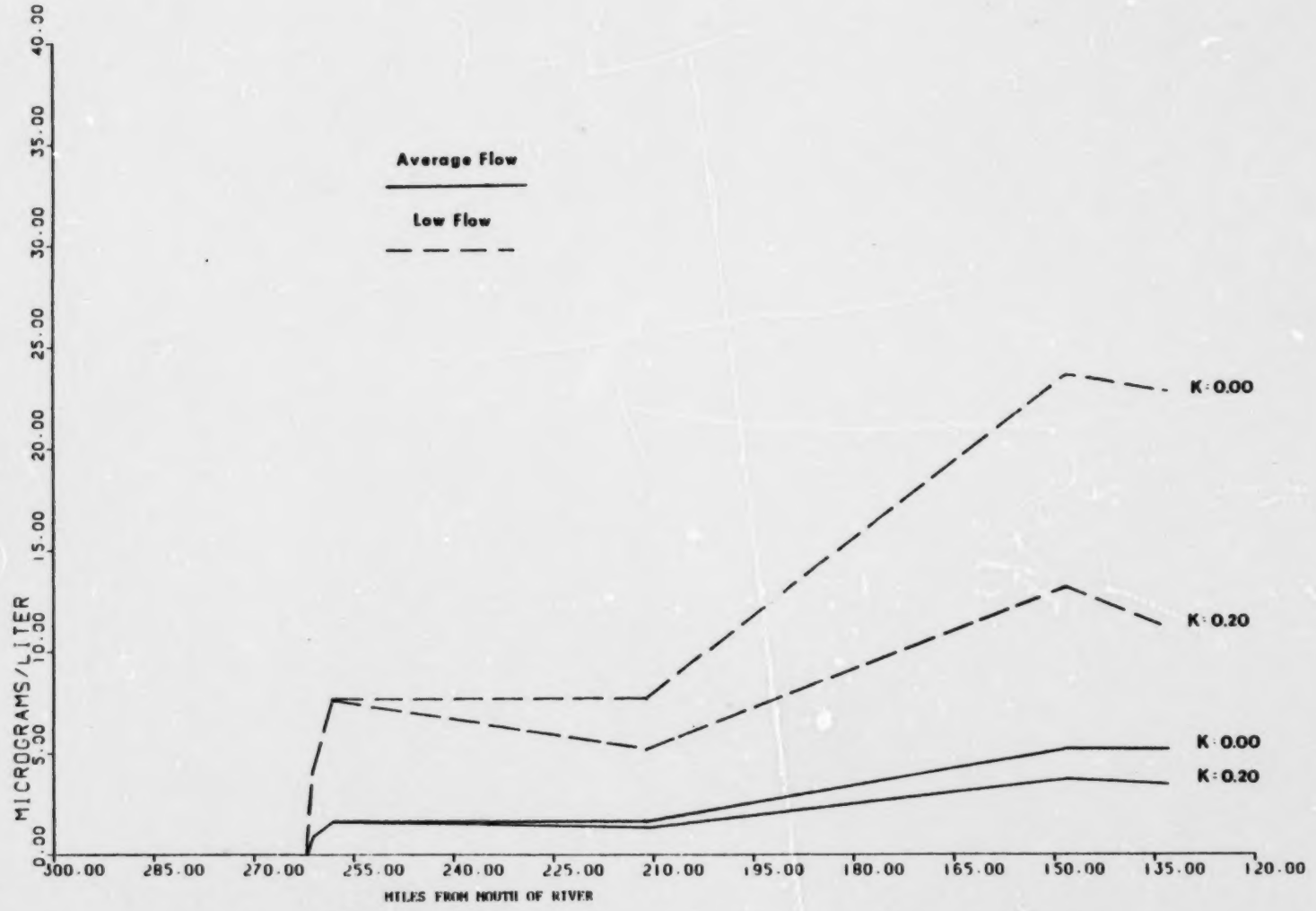



FIGURE V-3. EFFECT OF DISAPPEARANCE RATE(K) AND FLOW ON DICHLOROETHANE CONCENTRATIONS

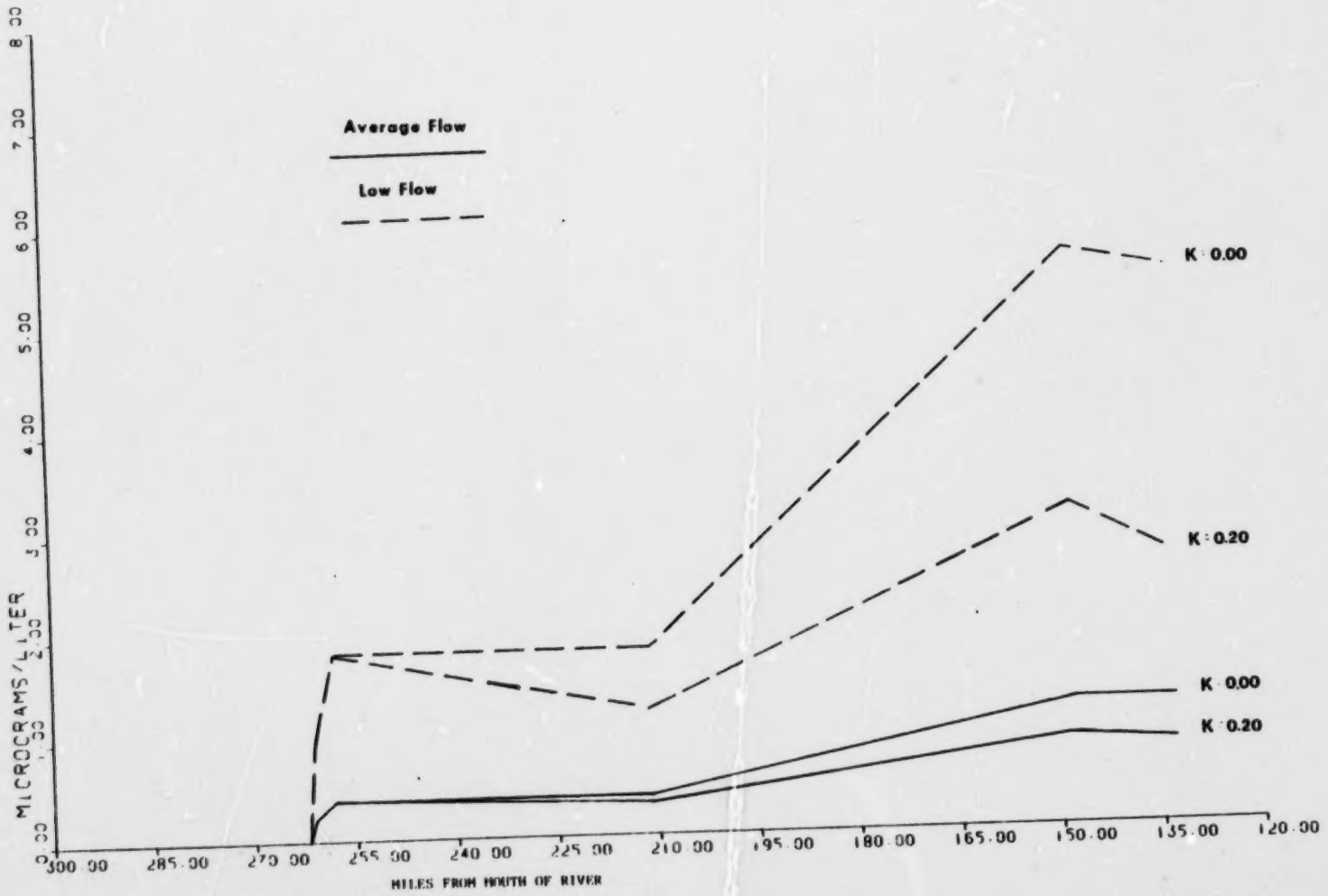



FIGURE V-4. EFFECT OF DISAPPEARANCE RATE(K) AND FLOW ON BENZENE CONCENTRATIONS

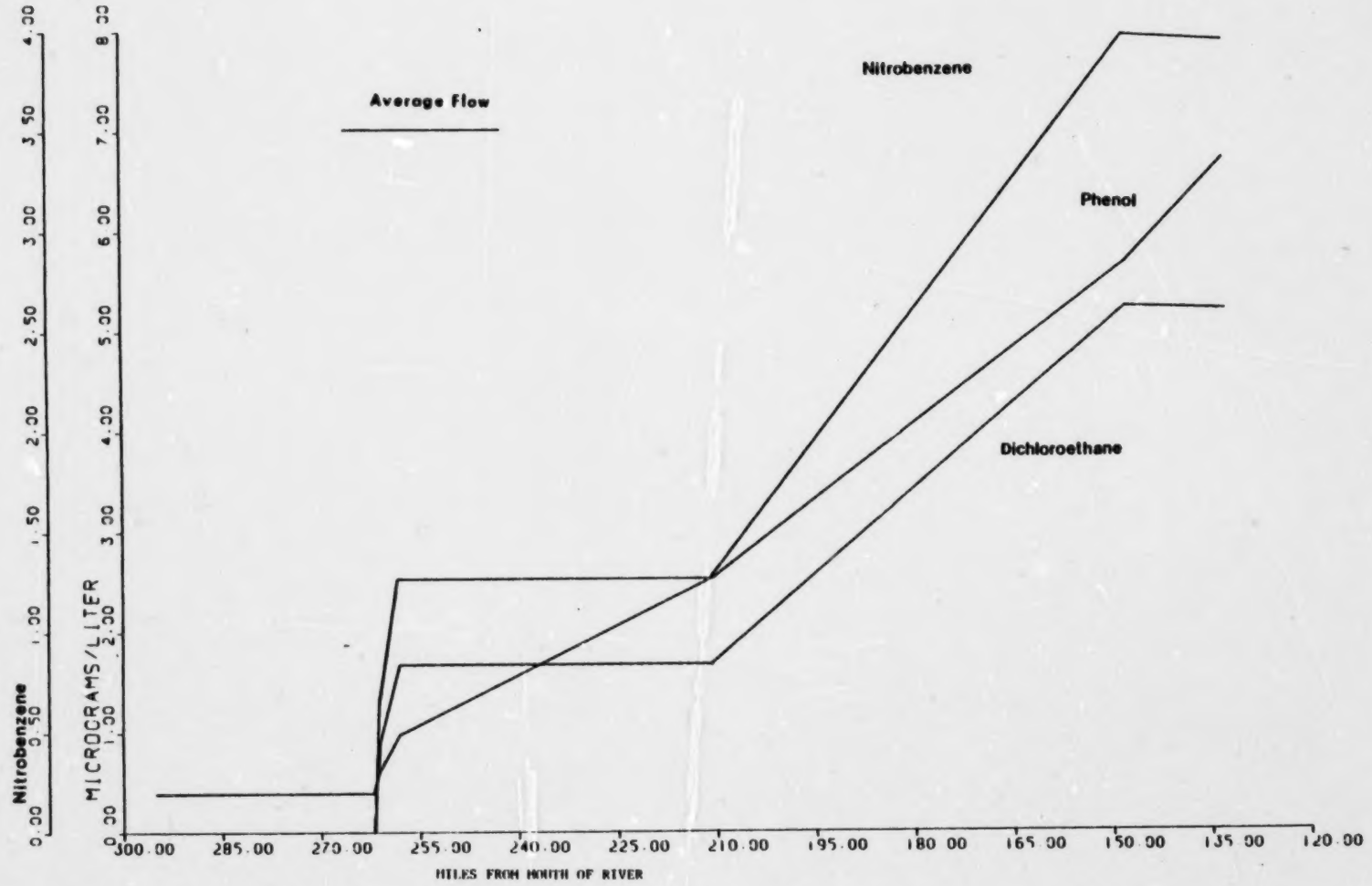



FIGURE V-5. CONCENTRATION PROFILES FOR DICHLOROETHANE, PHENOL AND NITROBENZENE WITH DISAPPEARANCE RATE=0

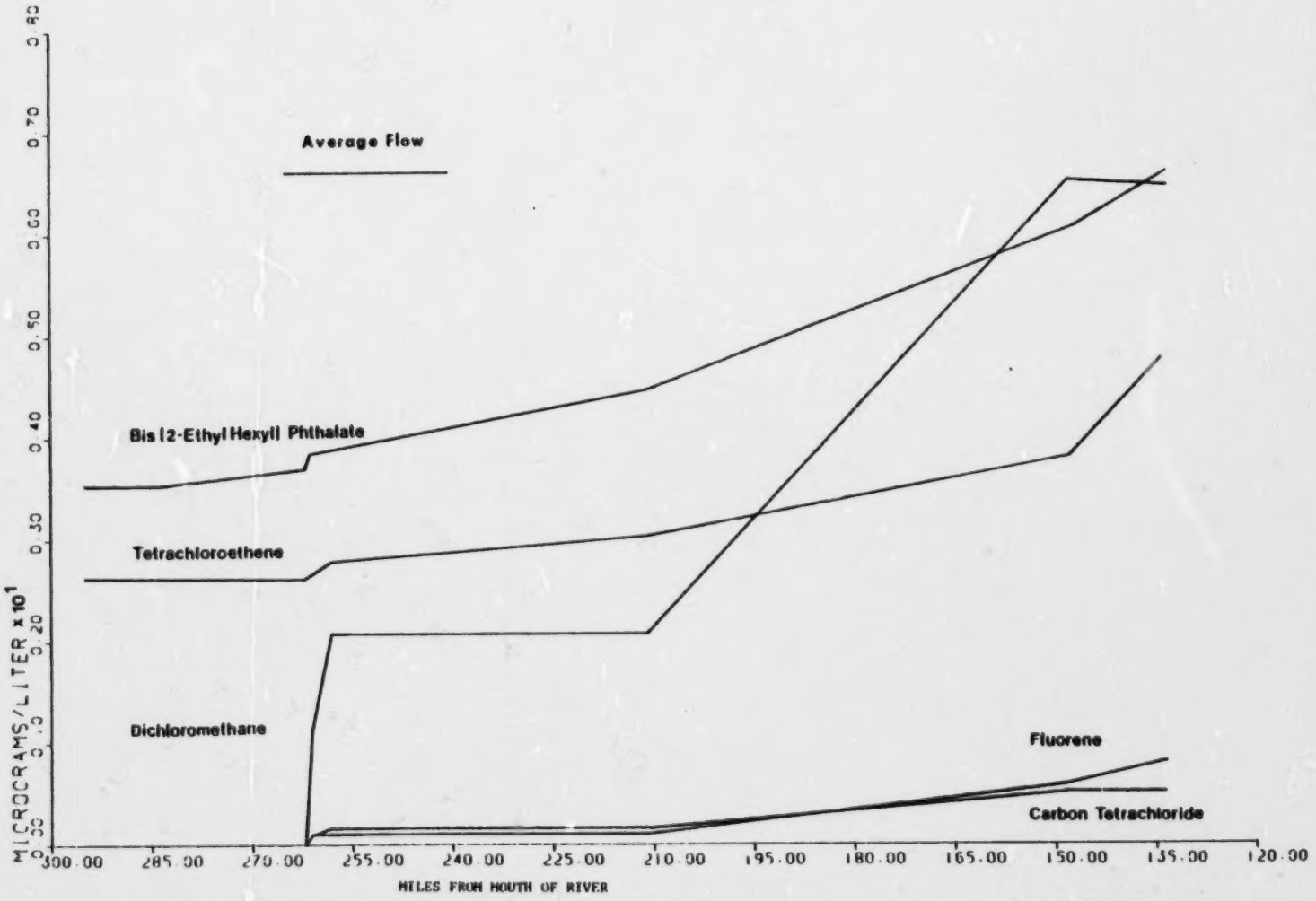



FIGURE V-6. CONCENTRATION PROFILES FOR DICHLOROMETHANE, CARBON TETRACHLORIDE, TETRACHLOROETHENE, BIS (2-ETHYL HEXYL) PHTHALATE AND FLUORENE WITH DISAPPEARANCE RATE=0

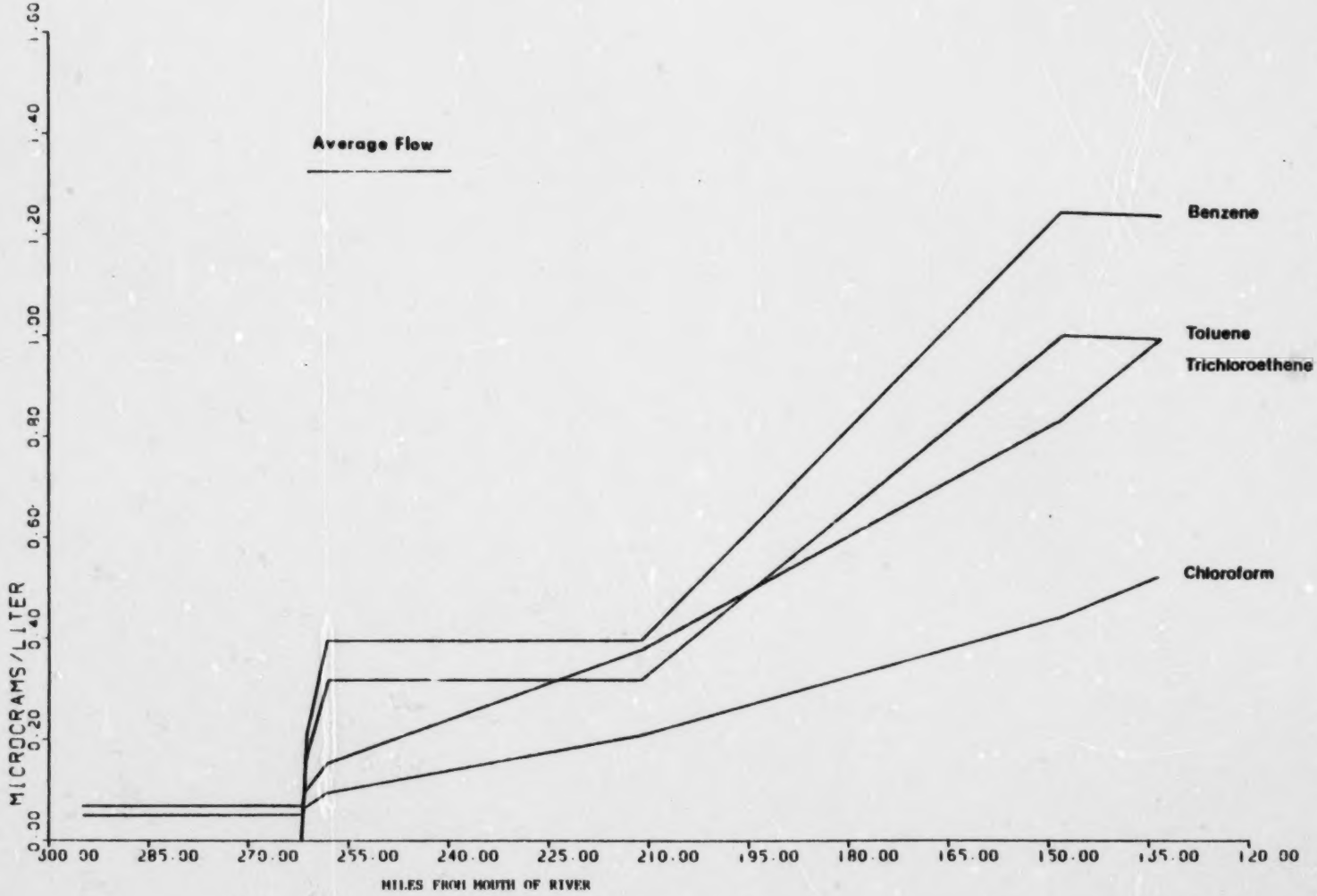
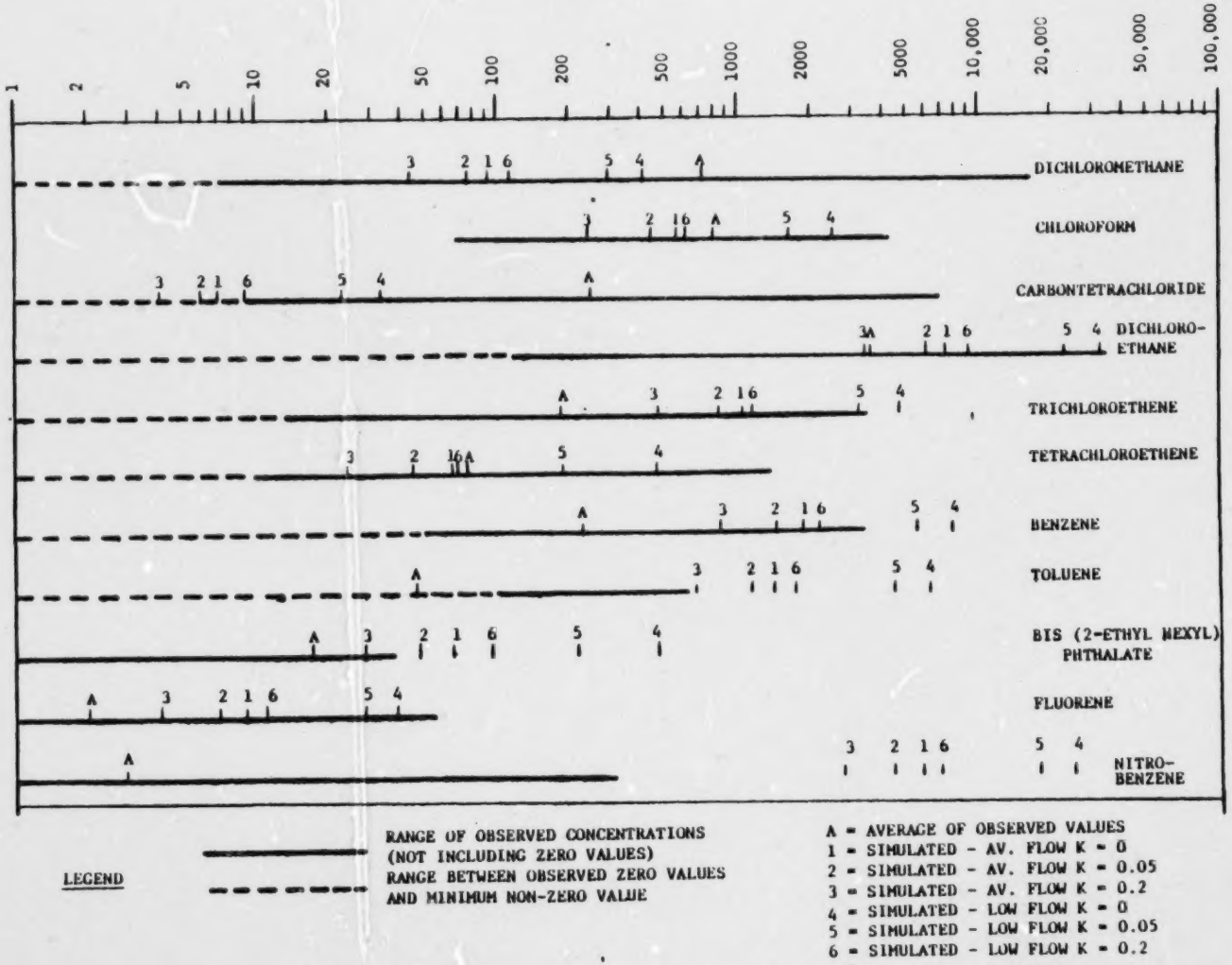



FIGURE V-7. CONCENTRATION PROFILES FOR CHLOROFORM, TRICHLOROETHENE, BENZENE AND TOLUENE WITH DISAPPEARANCE RATE=0

FIGURE V-8

COMPARISON OF OBSERVED AND SIMULATED CONCENTRATIONS



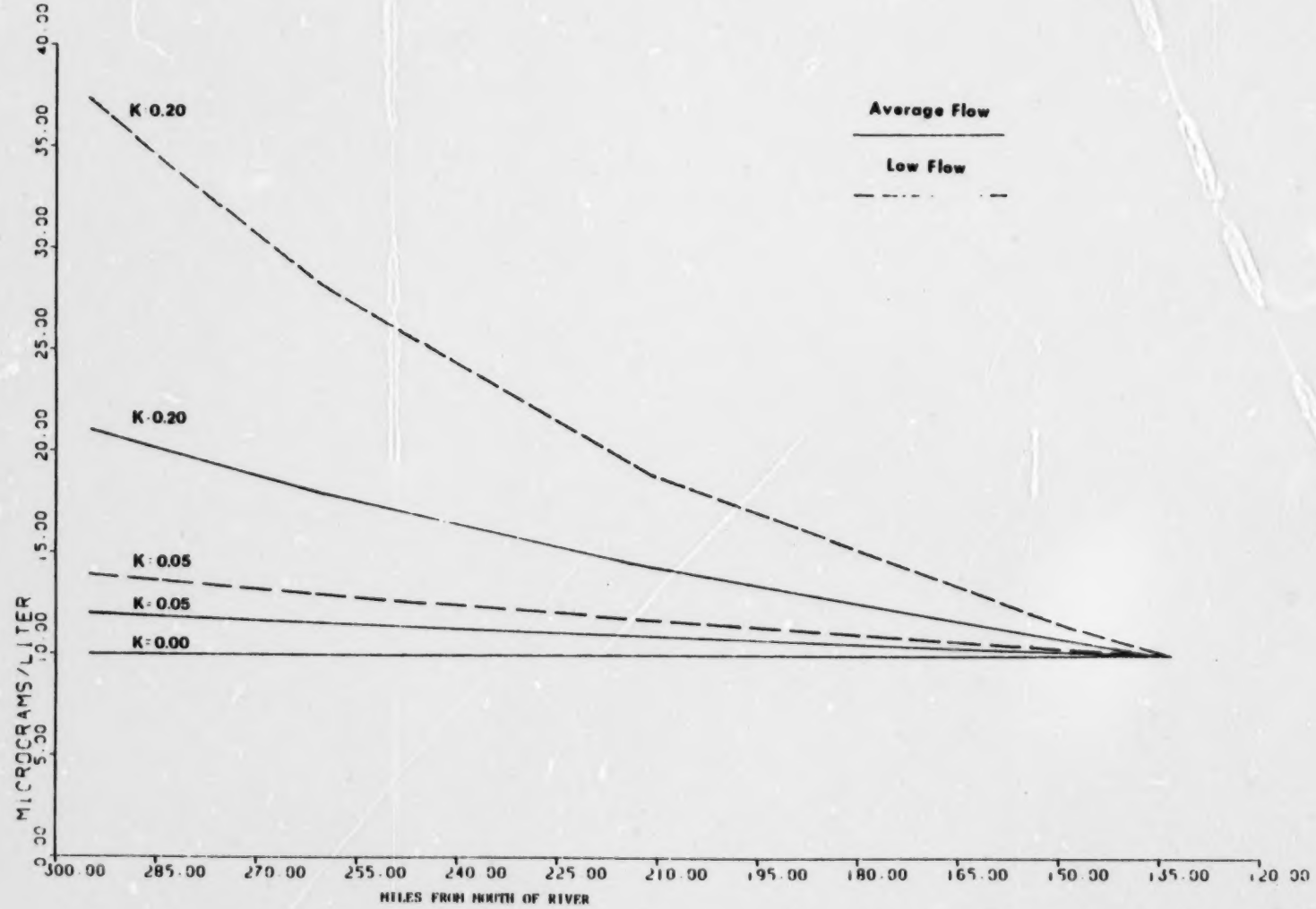



FIGURE V-9. UPSTREAM-DIRECTED CONCENTRATION PROFILES FOR THE LOWER MISSISSIPPI RIVER

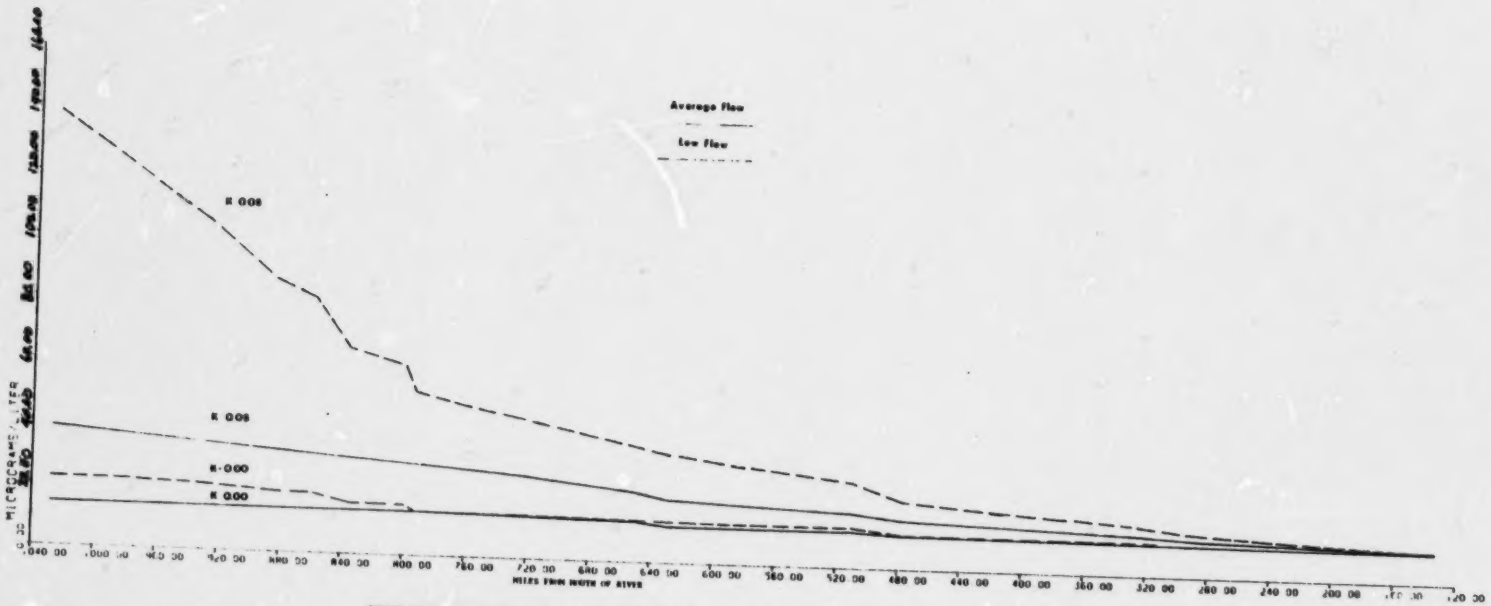



FIGURE V-10. UPSTREAM-DIRECTED CONCENTRATION PROFILES FOR THE MISSISSIPPI RIVER FROM THE OHIO RIVER TO NEW ORLEANS

TABLE V-1

COMPARISON OF SIMULATED CONCENTRATIONS TO

OBSERVED CONCENTRATIONS

| POLLUTANT | JEFFERSON PARISH | | SIMULATED CONCENTRATIONS ug/l | | | | | |
|---|---|---|---|---|---|---|---|---|
| | POLL. NO. | AVG. CONC. ug/l | AVERAGE FLOWS | | | LOW FLOWS | | |
| | | | K=0 | K=0.05 | K=0.2 | K=0 | K=0.05 | K=0.2 |
| Dichloromethane | 47 | 0.712 | 0.093 | 0.076 | 0.044 | 0.408 | 0.291 | 0.113 |
| Chloroform | 7 | 0.800 | 0.562 | 0.445 | 0.242 | 2.541 | 1.656 | 0.604 |
| Carbon Tetrachloride | 43 | 0.248 | 0.007 | 0.006 | 0.004 | 0.033 | 0.023 | 0.009 |
| 1,2 Dichloroethane | 23 | 3.585 | 7.412 | 6.116 | 3.507 | 32.635 | 23.318 | 9.080 |
| Trichloroethene | 35 | 0.188 | 1.061 | 0.846 | 0.464 | 4.781 | 3.150 | 1.159 |
| Tetrachloroethene | 126 | 0.075 | 0.065 | 0.045 | 0.024 | 0.454 | 0.189 | 0.069 |
| Benzene | 27 | 0.229 | 1.764 | 1.456 | 0.835 | 7.767 | 5.550 | 2.161 |
| Toluene | 31 | 0.046 | 1.417 | 1.169 | 0.670 | 6.238 | 4.459 | 1.736 |
| Bis (2-Ethyl Hexyl) Phthalate | 91 | 0.017 | 0.066 | 0.048 | 0.028 | 0.472 | 0.213 | 0.094 |
| Fluorene | 104 | 0.002 | 0.009 | 0.007 | 0.004 | 0.038 | 0.028 | 0.011 |
| Phenol | NA | NA | 7.135 | 5.708 | 3.140 | 31.581 | 21.196 | 7.804 |
| Nitrobenzene | 98 | 0.028 | 5.631 | 4.649 | 2.664 | 24.794 | 17.716 | 6.899 |

NA = Not Available

## SECTION VI

## CONCLUSIONS/RECOMMENDATIONS

### CONCLUSIONS

Although the technology represented by the Routing and Graphical Display System was appropriate to the task, the quality and specificity of the results would have been considerably enhanced had more specific information as to the types and quantities of contaminants actually discharged upstream been available and had specific disappearance rates been available for the selected contaminants.

The use of the downstream-directed and upstream-directed analysis capabilities in conjunction with the results of a water quality monitoring program, the IFD, and the pollutant loading matrix provide a way to compare the types and concentrations of contaminants being discharged as defined by the IFD and pollutant matrix with the types and concentrations of contaminants that would have to be discharged upstream to produce the observed types and concentrations of contaminants.

Contaminant contributions from runoff leachate, from contaminant disposal sites, and from spills were not considered in the conduct of the project. However, if the contaminant contribution from such sources can be quantified, the Routing and Graphical Display System technology can be used to simulate the resulting downstream concentrations.

In summary, the Routing and Graphical Display System is useful for conducting model based screening for estimating the types and concentrations of contaminants that might be expected to occur at a specified location downstream of discharges containing the contaminants, in any situation wherein the stream reaches involved are part of the Reach File System data

base. The quality of the screening results will be largely determined by the quality of the input data regarding the types and quantities of contaminants being discharged and the specificity with which the disappearance rate can be defined for each contaminant.

The user's objectives would determine which model, of which there are dozens to chose from, would be selected. Models such as EXAMS and TOXIWASP use a sophisticated kinetic structure that allows the study of different ionic forms of a chemical, several ways to calculate photolysis and other capabilities. Although the EXAMS fate module formulates a total transformation rate, the data requirements are extensive and could prove too costly in terms of time and money just to provide results for preliminary water resource planning strategies. As basic research on the fate of chemicals in lotic environments proceeds, it seems feasible that a refined overall disappearance rate for the priority pollutants will be available without having to determine the individual data necessary to operate EXAMS. Should the user require different hydraulics or chemical processes, then other models should be considered. However, for this analysis, the simple model presented is able to provide the level of results desired, given the resources available.

## RECOMMENDATIONS

Understanding the limitations of the approach and an awareness of the latest advances in the knowledge regarding the relationships between contaminants and the environment would be useful in improving the quality of screening results. Before implementation of the Routing and Graphical Display System, or any model, the following should be considered.

- Development of reasonable, accurate disappearance coefficients for either specific contaminants or specific classes of contaminants.

- Incorporation of more specific and detailed discharge contaminant loading data into the pollutant loading matrix, such as is available from NPDES permit applications, operating reports, and compliance monitoring.
- Apply the technology to other situations throughout the United States on a pilot scale where data of the type available from Jefferson Parish is available.

# APPENDIX A

## CONTAMINANTS PRESENT IN THE JEFFERSON PARISH DATA BASE

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| DELFLOG | DFLG | 1 | FLOW RATE(GPD)/24 HR PERIOD |
| CARBVOLCF | CARV | 2 | CARBON BED VOLUME(CU. FT.) |
| TOC | TOC | 3 | MG/L, TOTAL ORGANIC CARBON, INSTANTANEOUS READING, OOHRMAN |
| UV254 | UV25 | 4 | UV ABS,254 NM (ABS.UNITS) |
| EMF | EMF | 5 | EMISSION FLUORESCENCE (MULTIPLY EACH VALUE BY 100 FOR CORRECT READING) |
| RFM | RFM | 6 | RAPID FLUORESCENCE MEAS. |
| CHLROFRM | ICHC | 7 | NG/L, CHLOROFORM INSTANTANEOUS |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| | | | READING |
| TASCL3F | TASC | 8 | NG/L, CHLOROFORM TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSCL3F | TCSC | 9 | NG/L, CHLOROFROM TERMIANL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASCL3C | TCHC | 10 | NG/L, CHLOROFORM TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| BRDCLMET | IBR1 | 11 | NG/L, BROMODICHLOROMETHANE INSTANTANEOUS READING |
| TASBR1F | TASB | 12 | NG/L, BROMODICHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSBR1F | TCSB | 13 | NG/L, BROMODICHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASBR1C | TSBR | 14 | NG/L, BROMODICHLOROMETHANE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| CLDBRMET | IBR2 | 15 | NG/L, CHLORODIBROMOMETHANE INSTANTANEOUS READING |
| TASBR2F | TAS2 | 16 | NG/L, CHLORODIBROMOMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBINET, PH=AMBIENT |
| TCSBR2F | TCS2 | 17 | NG/L, CHLORODIBROMOMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASBR2C | TSB3 | 18 | NG/L, CHLORODIBROMOMETHANE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| BROMOFRM | IBR3 | 19 | NG/L, BROMOFORM INSTANTANEOUS READING |
| TASBR3F | TAS3 | 20 | NG/L, BROMOFORM TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSBR3F | TCS3 | 21 | NG/L, BROMOFORM TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASBR3C | TSB3 | 22 | NG/L, BROMOFORM TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| DCETAN | DCET | 23 | NG/L, DICHLOROETHANE-1,2, INSTANTANEOUS READING |
| TASDCETF | TADC | 24 | NG/L, DICHLOROETHANE-1,2 TERMINAL READING, STORED 5 DAYS, FREE |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| | | | CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSDCE1F | TCDC | 25 | NG/L, DICHLOROETHANE-1,2 TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASDCETC | TDCE | 26 | NG/L, DICHLOROETHANE-1,2 TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| BENZENE | BENZ | 27 | NG/L, BENZENE INSTANTANEOUS READING |
| TASBENZF | TABN | 28 | NG/L, BENZENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSBENZF | TCBN | 29 | NG/L, BENZENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASBENZC | TBNC | 30 | NG/L, BENZENE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TOLUENE | TOLU | 31 | NG/L, TOLUENE INSTANTANEOUS READING |
| TASTOLUF | TATO | 32 | NG/L, TOLUENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSTOLUF | TCTO | 33 | NG/L, TOLUENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASTOLUC | TTOL | 34 | NG/L, TOLUENE, TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TRCETEN | TRCE | 35 | NG/L, TRICHLOROETHYLENE INSTANTANEOUS READING |
| TASTRCEF | TATR | 36 | NG/L, TRICHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSTRCEF | TCTR | 37 | NG/L, TRICHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TASTRCEC | TTRC | 38 | NG/L, TRICHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| ETHCETAN | TRC2 | 39 | NG/L, TRICHLOROETHANE-1,1,2 INSTANTANEOUS READING |
| TAS2C3EF | TAT2 | 40 | NG/L, TRICHLOROETHANE-1,1,2 TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCS2C3EF | TCT2 | 41 | NG/L, TRICHLOROETHANE-1,1,2 TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TAS2C3EC | TTR2 | 42 | NG/L, TRICHLOROETHANE-1,1,2 TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| TCLMETAN | TCM4 | 43 | NG/L, TETRACHLOROMETHANE, INSTANTANEOUS READING |
| TA5TCMTF | TATC | 44 | NG/L, TETRACHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TC5TCMTF | TCTC | 45 | NG/L, TETRACHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TA5TCMTC | TTCM | 46 | NG/L, TETRACHLOROMETHANE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| DCMETAN | DCM2 | 47 | NG/L, DICHLOROMETHANE INSTANTANEOUS READING |
| TA5DCMAF | TAD3 | 48 | NG/L, DICHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TA5DCMAC | TDC4 | 49 | NG/L, DICHLOROMETHANE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| BRCLMETH | BRC4 | 50 | NG/L, BROMOCHLOROMETHANE INSTANTANEOUS READING |
| TA5BCMAF | TAB4 | 51 | NG/L, BROMOCHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TC5BCMAF | TCBR | 52 | NG/L, BROMOCHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TA5BCMAC | TBFC | 53 | NG/L, BROMOCHLOROMETHANE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBINET |
| DCLETHYL | DCE2 | 54 | NG/L, DICHLOROETHYLENE INSTANTANEOUS READING |
| TA5DCEYF | TAD5 | 55 | NG/L, DICHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TC5DCEYF | TDC4 | 56 | NG/L, DICHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TA5DCE1C | TDC5 | 57 | NG/L, DICHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| CLBNZ | CLB4 | 58 | NG/L, CHLOROBENZENE INSTANTANEOUS READING |
| TA5CLBZF | TACL | 59 | NG/L, CHLOROBENZENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TC5CLBZF | TCCL | 60 | NG/L, CHLOROBENZENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TA5CLBZC | TCL5 | 61 | NG/L, CHLOROBENZENE TERMINAL READING, STORED 5 DAYS, COMBINED |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| | | | CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| MDICLBNZ | DCBM | 62 | NG/L, DICHLOROBENZENE-META INSTANTANEOUS READING |
| TABMDCBF | TAD1 | 63 | NG/L, DICHLOROBENZENE-META, TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSMDCBF | TCD1 | 64 | NG/L, DICHLOROBENZENE-META TERMINAL READING, FREE CHLORINE, STORED 5 DAYS, TEMP=10C, PH=10 |
| TABMDCMC | TDCB | 65 | NG/L, DICHLOROBENZENE-META TERMINAL READING, STORED 5 DAYS, COMBINED CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| ABHC | ABHC | 66 | NG/L, ALPHA BENZENE HEXACHLORIDE (BHC) |
| BBHC | BBHC | 67 | NG/L, BETA BENZENE HEXACHLORIDE (BHC) |
| GBHC | GBHC | 68 | NG/L, GAMMA BENZENE HEXACHLORIDE (BHC, LINDANE) |
| HXCLBNZ | HACL | 69 | NG/L, HEXACHLOROBENZENE INSTANTANEOUS READING |
| HEPTACLR | HEPT | 70 | NG/L, HEPTACHLOR INSTANTANEOUS READING |
| ACHLRDEN | ACHL | 71 | NG/L, ALPHA CHLORDENE-INSTANTANEOUS READING |
| BCHLRDEN | BCHL | 72 | NG/L, BETA CHLORDENE-INSTANTANEOUS READING |
| GCHLRDEN | GCHL | 73 | NG/L, GAMMA CHLORDENE-INSTANTANEOUS READING |
| ALDRIN | ALDR | 74 | NG/L, ALDRIN INSTANTANEOUS READING |
| HEPCLREP | HEPC | 75 | NG/L, HEPTACHLOR EPOXIDE INSTANTANEOUS READING |
| ACHLRDAN | ACH2 | 76 | NG/L, ALPHA CHLORDANE-INSTANTANEOUS READING |
| GCHLRDAN | GCH2 | 77 | NG/L, GAMMA CHLORDANE-INSTANTANEOUS READING |
| 24DDE | 24DD | 78 | NG/L, ORTHO, PARA'-DDE INSTANTANEOUS READING |
| 44DDE | 44DD | 79 | NG/L, PARA,PARA'-DDE INSTANTANEOUS READING |
| ENDSULF1 | END1 | 80 | NG/L, ENDOSULFAN-1 INSTANTANEOUS READING |
| ENDSULF2 | END2 | 81 | NG/L, ENDOSULFAN-2 INSTANTANEOUS READING |
| DIELDRIN | DIEL | 82 | NG/L, DIELDRIN INSTANTANEOUS READING |
| 24DDD | 24D3 | 83 | NG/L, ORTHO,PARA'-DDD INSTANTANEOUS READING |
| 44DDD | 44D3 | 84 | NG/L, PARA, PARA'-DDD INSTANTANEOUS READING |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| ENDRIN | ENDP | 85 | NG/L, ENDRIN INSTANTANEOUS READING |
| 24DDT | 24DT | 86 | NG/L, ORTHO, PARA'-DDT INSTANTANEOUS READING |
| 44DDT | 44DT | 87 | NG/L, PARA,PARA'-DDT INSTANTANEOUS READING |
| PHOTODIEL | PHOT | 88 | NG/L, PHOTODIELDRIN INSTANTANEOUS READING |
| METHOCLR | METH | 89 | NG/L, METHOXYCHLOR INSTANTANEOUS READING |
| MIREX | MIRE | 90 | NG/L, MIREX INSTANTANEOUS READING |
| BZETLHXH | BZET | 91 | NG/L, BIS(2-ETHYL HEXYL) PHTHALATE INSTANTANEOUS READING |
| NDECANE | NDEC | 92 | NG/L, DECANE-N INSTANTANEOUS READING |
| NUNDECAN | NUND | 93 | NG/L, UNDECANE-N INSTANTANEOUS READING |
| NDODECAN | NDOD | 94 | NG/L, DODECANE-N INSTANTANEOUS READING |
| NTRIDEC | NTRI | 95 | NG/L, TRIDECANE-N, INSTANTANEOUS READING |
| NTETRDEC | NTET | 96 | NG/L, TETRADECANE-N, INSTANTANEOUS READING |
| NPENTDEC | NPEN | 97 | NG/L, PENTADECANE-N INSTANTANEOUS READING |
| NITROBNZ | NITR | 98 | NG/L, NITROBENZENE INSTANTANEOUS READING |
| ISOPHORO | ISOP | 99 | NG/L, ISOPHORONE INSTANTANEOUS READING |
| BIPHENYL | BIPH | 100 | NG/L, BIPHENYL INSTANTANEOUS READING |
| DMETHPHT | DMET | 101 | NG/L, DIMETHYL PHTHALATE INSTANTANEOUS READING |
| ACENAPHE | ACEN | 102 | NG/L, ACENAPHTHENE INSTANTANEOUS READING |
| DETHPHTH | DETH | 103 | NG/L, DIETHYLPHTHALATE INSTANTANEOUS READING. |
| FLUORENE | FLUO | 104 | NG/L, FLOURENE INSTANTANEOUS READING (PAH) |
| ATRAZINE | ATRA | 105 | NG/L, ATRAZINE INSTANTANEOUS READING |
| DPROPHTH | DPRO | 106 | NG/L, DIPROPYL PHTHALATE INSTANTANEOUS READING |
| PHENANTH | PHEA | 107 | NG/L, PHENANTHRENE INSTANTANEOUS READING (PAH) |
| ANTHRACE | ANTR | 108 | NG/L, ANTHRACENE INSTANTANEOUS READING |
| DIBUPHTH | DIPH | 109 | NG/L, DI-ISOBUTYLPHTHALATE INSTANTANEOUS READING |
| DNBUPHTH | DNBU | 110 | NG/L, DI-N-BUTYLPHTHALATE, INSTANTANEOUS READING |
| TRPHMTHT | TRPH | 111 | NG/L, TRIPHENYLMETHANE |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| | | | INSTANTANEOUS READING |
| FLURANEN | FLOR | 112 | NG/L, FLUORANTHENE, INSTANTANEOUS READING (PAH) |
| PYRENE | PYRE | 113 | NG/L, PYRENE INSTANTANEOUS READING (PAH) |
| CARBONAT | CO3 | 114 | MG/L, CARBONATES INSTANTANEOUS READING |
| BICARBON | HCO3 | 115 | MG/L, BICARBONATES INSTANTANEOUS READING |
| CALCIUM | CALC | 116 | MG/L, CALCIUM INSTANTANEOUS READING |
| TOT.HARD | TOT. | 117 | TOTAL HARDNESS MG/L |
| PH | PH | 118 | INITIAL PH SAMPLE |
| TURB | TURB | 119 | (NTU) TURBIDITY |
| CLTOTAL | CLTO | 120 | MG/L, TOTAL CHLORINE RESIDUAL-ORTHO TOLIDENE |
| TDS | TDS | 121 | MG/L, TOTAL DISSOLVED SOLIDS |
| TSS | TSS | 122 | MG/L, TOTAL SUSPENDED SOLIDS |
| TOT.COLI | COLI | 123 | TOTAL COLIFORM(CTS/100ML) |
| SPC | SPC | 124 | TOTAL BACTERIA (CTS/ML) |
| TEMPSAMP | TEMP | 125 | (DEG C) TEMPERATURE OF SAMPLE |
| TCEIEN | TCEI | 126 | NG/L, TETRACHLOROETHYLENE INSTANTANEOUS READING |
| TASICEIF | TAT5 | 127 | NG/L, TETRACHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSICEIF | TCT4 | 129 | NG/L, TETRACHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| ECDIUAN | ECTO | 129 | SUM OF ALL PEAK AREAS IN CHROMATOGRAM-SEE REPORT |
| FIDIUAN | FIDT | 130 | SUM OF PEAK AREAS IN CHROMATOGRAM-SEE REPORT |
| CLREIHYL | CLET | 131 | NG/L, CHLOROETHYLENE INSTANTANEOUS READING |
| TASCLELF | TAC5 | 132 | NG/L, CHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSCLELF | TCC2 | 133 | NG/L, CHLOROETHYLENE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TCLRETAN | TECE | 134 | NG/L, TETRACHLOROETHANE-1,1,2,2 INSTANTANEOUS READING |
| TASCL4EF | TAEC | 135 | NG/L, TETRACHLOROETHANE-1,1,2,2 TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT, PH=AMBIENT |
| TCSCL4EF | TCEC | 136 | NG/L, TETRACHLOROETHANE-1,1,2,2 TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| PCLRNBNZ | PCLR | 137 | NG/L, PENTACHLORONITROBENZENE INSTANTANEOUS READING |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| DCPA | DCPA | 138 | NG/L, DIMETHYL-2,3,5,6-TETRACHLOROTERE PHTHALATE |
| OXCHLDAN | OXC4 | 139 | NG/L, OXY-CHLORDAN INSTANTANEOUS READING |
| 34DDD | 34DD | 140 | NG/L, META, PARA'-DDD INSTANTANEOUS READING |
| PERTHANE | PERT | 141 | NG/L, PERTHANE INSTANTANEOUS READING |
| BNZNITRL | BNZN | 142 | NG/L, BENZONITRILE INSTANTANEOUS READING |
| BNZYCYAN | BNZY | 143 | NG/L, BENZYL CYANIDE INSTANTANEOUS READING |
| 2NITRTOL | 2NIT | 144 | NG/L, NITROTOLUENE-2 INSTANTANEOUS READING |
| ETLBNZ | ETBN | 145 | NG/L, ETHYL BENZENE INSTANTANEOUS READING |
| NPTHALEN | NPTH | 146 | NG/L, NAPHTHALENE INSTANTANEOUS READING (PAH) |
| CLRNTBNZ | CLRN | 147 | NG/L, CHLORONITROBENZENE-ORTHO (ALSO 1-CHLORO-2NITROBENZENE) INSTANTANEOUS READING |
| METHNAPH | MET3 | 148 | NG/L, METHYL NAPHALENE, INSTANTANEOUS READING (PAH) |
| ACNPTHON | ACNP | 149 | NG/L, ACETONAPHTHONE-2' INSTANTANEOUS READING (PAH) |
| NHEXADEC | NHEX | 150 | NG/L, HEXADECANE-N, INSTANTANEOUS READING |
| NHEPTDEC | NHEP | 151 | NG/L, HEPTADECANE-N INSTANTANEOUS READING |
| NOCTADEC | NOCT | 152 | NG/L, OCTADECANE-N INSTANTANEOUS READING |
| NNONDECA | NNON | 153 | NG/L, NONADECANE-N INSTANTANEOUS READING |
| NEICOSAN | NEIC | 154 | NG/L, EICOSANE-N INSTANTANEOUS READING |
| FEC.COLI | FEC. | 155 | FECAL COLIFORM (CTS/100ML) |
| DO2 | DO2 | 156 | MG/L, DISSOLVED OXYGEN INSTANTANEOUS READING |
| TCSOCMAF | TCDS | 157 | NG/L, DICHLOROMETHANE TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=30C, PH=10 |
| TOT | TOT | 158 | FOR CALC PROGRAM |
| TOT2 | TOT2 | 159 | FOR CALC PROGRAM |
| DIF | DIF | 160 | FOR CALC PROGRAM |
| DIF2 | DIF2 | 161 | FOR CALC PROGRAM |
| TASTTHMF | STMA | 162 | UG/L TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, TEMP=AMBIENT |
| TCSTTHMF | STMC | 163 | UG/L TERMINAL READING, STORED 5 DAYS, FREE CHLORINE, CONSTANT TEMP |

| FIELD NAME | ABBR | VALUE | DESCRIPTION |
|---|---|---|---|
| CATEGORIES (CONTINUED) | | | |
| TTHM | ITHM | 164 | UG/L INSTANTANEOUS READING, SUM OF FOUR TRIHALOMETHANE READINGS |
| ACARVOL | ACVL | 165 | AVG. CARBON VOLUME DURING PHASE IN CUBIC FEET OF CARBON. LOSSES DURING EACH PHASE. |
| CARBNTVP | CNVP | 166 | AVG. CARBON WEIGHT DURING EACH PHASE IN POUNDS BASED ON 25#/CF FOR PHASE I, IIA, IIB & 25.5#/CF FOR PHASE III. LOSSES IN EACH PHASE FOR FULL SCALE SYSTEMS, BUT NOT PILOT COLUMNS. SEE CARVOL PARM FOR VARYING VOLUMES. |
| CARBNTVK | CNVK | 167 | AVG. CARBON WEIGHT DURING EACH PHASE IN KILOGRAMS, CALCULATED FROM CNVP / 2.2. LOSSES IN EACH PHASE. |
| CARBNTVG | CNVG | 168 | CARBON WEIGHT IN PILOT COLUMNS FOR EACH PHASE BASED ON 25#/CF FOR PHASE I, IIA, IIB & 25.5#/CF FOR PHASE III. NO CARBON LOSSES. |
| SUMFLOG | SFLG | 169 | SUMMATION FLOW IN U.S. GALLONS |
| SUMFLOL | SFLL | 170 | SUMMATION FLOW IN LITERS |
| SUMFLOMG | SFLM | 171 | SUMMATION FLOW IN MILLION GALLONS |
| SUMFLOTG | SFLT | 172 | SUMMATION FLOW IN 1000 U.S. GALLONS |

# APPENDIX B

# STATISTICAL ANALYSIS OF JEFFERSON PARISH WATER QUALITY DATA

TABLE B-1

STATISTICAL ANALYSIS OF CONCENTRATION OF POLLUTANTS

AT JEFFERSON PARISH

| Cons. No. | No. of Obs. | Av. Conc. | S.D. Conc. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (CxF) | Corr. (CxF) | Corr. (CxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3* | 255 | 3.847 | .809 | 513.75 | 289.40 | 431.97 | 302.58 | .12 | .10 | .84 |
| 4* | 200 | 0.221 | .103 | 570.28 | 291.77 | 473.64 | 307.52 | .33 | .50 | .82 |
| 5* | 241 | 291931.500 | 439029.125 | 528.99 | 289.99 | 447.69 | 301.94 | -.18 | -.12 | .84 |
| 6* | 250 | 91.663 | 22.768 | 518.94 | 289.44 | 437.58 | 302.13 | .19 | .23 | .84 |
| 7 | 209 | 799.758 | 632.819 | 517.49 | 304.82 | 425.40 | 299.62 | -.42 | -.32 | .85 |
| 8 | 204 | 226460.625 | 92467.187 | 521.85 | 307.34 | 429.33 | 302.09 | .16 | .11 | .84 |
| 9 | 80 | 309652.750 | 93780.062 | 551.95 | 318.94 | 449.82 | 293.79 | .29 | .24 | .84 |
| 10 | 52 | 5517.152 | 3714.616 | 391.54 | 196.85 | 330.79 | 286.61 | -.04 | -.07 | .88 |
| 11 | 209 | 60.631 | 184.233 | 517.69 | 304.82 | 425.40 | 299.62 | -.15 | -.12 | .85 |
| 12 | 204 | 29234.637 | 13214.648 | 521.85 | 307.36 | 429.33 | 302.09 | -.44 | -.47 | .84 |
| 13 | 80 | 21128.023 | 13796.340 | 551.95 | 318.94 | 449.82 | 293.78 | -.06 | -.14 | .84 |
| 14 | 52 | 184.654 | 582.656 | 391.54 | 196.85 | 330.79 | 286.61 | .18 | .14 | .88 |
| 15 | 209 | 520.177 | 2024.829 | 517.69 | 304.82 | 425.40 | 299.62 | -.09 | -.09 | .85 |
| 16 | 204 | 5060.730 | 5602.324 | 521.85 | 307.36 | 429.33 | 302.09 | -.45 | -.43 | .84 |
| 17 | 80 | 3433.900 | 2467.088 | 551.95 | 318.96 | 449.82 | 293.79 | -.31 | -.32 | .84 |
| 18 | 52 | 2204.250 | 3998.904 | 391.54 | 196.85 | 330.79 | 286.61 | .09 | .05 | .88 |
| 19 | 209 | 0.0 | 0.0 | 517.69 | 304.82 | 425.40 | 299.62 | .00 | .00 | .85 |
| 20 | 204 | 55.284 | 132.900 | 521.85 | 307.36 | 429.33 | 302.09 | -.26 | -.21 | .84 |
| 21 | 80 | 114.235 | 293.534 | 551.95 | 318.96 | 449.82 | 293.79 | -.23 | -.25 | .84 |
| 22 | 52 | 0.0 | 0.0 | 391.54 | 196.85 | 330.79 | 286.61 | .00 | .00 | .88 |
| 23 | 209 | 3585.385 | 4889.340 | 517.69 | 304.82 | 425.40 | 299.62 | -.34 | -.31 | .85 |
| 24 | 204 | 3642.407 | 4396.484 | 521.85 | 307.34 | 429.33 | 302.09 | -.33 | -.29 | .84 |
| 25 | 80 | 1781.777 | 2077.820 | 551.95 | 318.96 | 449.82 | 293.79 | -.34 | -.34 | .84 |
| 26 | 52 | 8295.922 | 5914.082 | 391.54 | 196.85 | 330.79 | 286.61 | -.38 | -.38 | .88 |
| 27 | 103 | 229.233 | 525.415 | 486.18 | 212.15 | 445.32 | 319.79 | -.07 | -.08 | .93 |
| 28 | 102 | 285.470 | 548.094 | 487.24 | 212.92 | 447.28 | 320.75 | -.06 | -.06 | .93 |
| 29 | 25 | 584.000 | 675.573 | 584.72 | 182.67 | 564.16 | 314.16 | -.29 | -.21 | .97 |
| 30 | 52 | 165.344 | 305.303 | 391.54 | 196.85 | 330.79 | 286.61 | -.19 | -.17 | .88 |
| 31 | 103 | 45.524 | 99.720 | 486.18 | 212.15 | 445.32 | 319.79 | -.02 | -.01 | .93 |
| 32 | 102 | 51.941 | 93.259 | 487.24 | 212.92 | 447.28 | 320.75 | -.09 | -.12 | .93 |
| 33 | 25 | 80.000 | 64.550 | 584.72 | 182.67 | 564.16 | 314.16 | -.27 | -.21 | .97 |
| 34 | 52 | 56.308 | 140.707 | 391.54 | 196.85 | 330.79 | 286.61 | -.09 | -.13 | .88 |
| 35 | 209 | 188.192 | 395.604 | 517.69 | 304.82 | 425.40 | 299.62 | .00 | .02 | .85 |
| 36 | 204 | 254.578 | 1131.209 | 521.85 | 307.34 | 429.33 | 302.09 | -.06 | -.03 | .84 |
| 37 | 80 | 254.375 | 656.395 | 551.95 | 318.96 | 449.82 | 293.79 | .02 | .21 | .84 |
| 38 | 52 | 132.904 | 243.854 | 391.54 | 196.85 | 330.79 | 286.61 | -.15 | -.09 | .88 |
| 39 | 209 | 196.044 | 537.579 | 517.69 | 304.82 | 425.40 | 299.62 | -.26 | -.27 | .85 |
| 40 | 204 | 176.721 | 331.879 | 521.85 | 307.36 | 428.33 | 302.09 | -.30 | -.31 | .84 |

TABLE B-1 (Cont'd)

| Cons. No. | No. of Obs. | Av. Conc. | S.D. Conc. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (CxF) | Corr. (CxF) | Corr. (CxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 41 | 80 | 152.505 | 255.079 | 551.95 | 318.96 | 449.82 | 293.79 | -.03 | .01 | .84 |
| 42 | 52 | 206.250 | 427.583 | 391.54 | 196.85 | 330.79 | 286.61 | -.31 | -.31 | .88 |
| 43 | 209 | 248.424 | 1006.378 | 517.69 | 304.82 | 425.40 | 299.62 | -.12 | -.09 | .85 |
| 44 | 204 | 133.554 | 329.731 | 521.85 | 307.36 | 429.33 | 302.09 | -.10 | -.05 | .84 |
| 45 | 80 | 65.497 | 71.037 | 551.95 | 318.96 | 449.82 | 293.79 | -.26 | -.12 | .84 |
| 46 | 52 | 306.788 | 851.011 | 391.54 | 196.85 | 330.79 | 286.61 | -.07 | .00 | .88 |
| 47 | 209 | 712.033 | 1823.695 | 517.69 | 304.82 | 425.40 | 299.62 | -.22 | -.18 | .85 |
| 48 | 204 | 800.294 | 1691.843 | 521.85 | 307.36 | 429.33 | 302.09 | -.20 | -.17 | .84 |
| 49 | 81 | 2605.249 | 5222.174 | 365.51 | 186.82 | 317.00 | 265.16 | .01 | -.01 | .89 |
| 50 | 209 | 59.000 | 148.849 | 517.69 | 304.82 | 425.40 | 299.62 | -.15 | -.10 | .85 |
| 51 | 204 | 368.961 | 1400.173 | 521.85 | 307.36 | 429.33 | 302.09 | -.06 | .00 | .84 |
| 52 | 80 | 1443.262 | 4120.246 | 551.95 | 318.96 | 449.82 | 293.79 | .03 | -.07 | .84 |
| 53 | 52 | 3957.000 | 6123.584 | 391.54 | 196.85 | 330.79 | 286.61 | -.07 | -.04 | .88 |
| 54 | 209 | 0.0 | 0.0 | 517.69 | 304.82 | 425.40 | 299.62 | .00 | .00 | .85 |
| 55 | 204 | 4.363 | 41.178 | 521.85 | 307.36 | 429.33 | 302.09 | -.04 | -.03 | .84 |
| 56 | 80 | 0.0 | 0.0 | 551.95 | 318.96 | 449.82 | 293.79 | .00 | .00 | .84 |
| 57 | 52 | 0.0 | 0.0 | 391.54 | 196.85 | 330.79 | 286.61 | .00 | .00 | .88 |
| 58 | 209 | 16.311 | 134.372 | 517.69 | 304.82 | 425.40 | 299.62 | -.11 | -.13 | .85 |
| 59 | 204 | 34.049 | 121.749 | 521.85 | 307.36 | 429.33 | 302.09 | .01 | .02 | .84 |
| 60 | 80 | 6.250 | 55.902 | 551.95 | 318.96 | 449.82 | 293.79 | -.05 | -.05 | .84 |
| 61 | 52 | 46.154 | 218.247 | 391.54 | 196.85 | 330.79 | 286.61 | -.19 | -.19 | .88 |
| 62 | 209 | 9.550 | 131.561 | 517.69 | 304.82 | 425.40 | 299.62 | -.08 | -.09 | .85 |
| 63 | 204 | 0.0 | 0.0 | 521.85 | 307.34 | 429.33 | 302.09 | .00 | .00 | .84 |
| 64 | 80 | 0.0 | 0.0 | 551.95 | 318.96 | 449.82 | 293.79 | .00 | .00 | .84 |
| 65 | 52 | 0.0 | 0.0 | 391.54 | 196.85 | 330.79 | 286.61 | .00 | .00 | .88 |
| 66 | 304 | 1.911 | 0.951 | 522.83 | 305.52 | 430.64 | 299.35 | -.04 | .06 | .84 |
| 67 | 305 | 1.406 | 2.776 | 521.89 | 305.47 | 429.61 | 299.41 | .35 | .09 | .84 |
| 68 | 305 | 0.988 | 0.823 | 521.89 | 305.47 | 429.61 | 299.41 | -.10 | -.04 | .84 |
| 69 | 305 | 0.805 | 1.542 | 521.89 | 305.47 | 429.61 | 299.41 | -.04 | -.07 | .84 |
| 70 | 305 | 0.163 | 0.275 | 521.89 | 305.47 | 429.61 | 299.41 | -.11 | -.12 | .84 |
| 71 | 305 | 0.032 | 0.089 | 521.89 | 305.47 | 429.61 | 299.41 | -.17 | -.08 | .84 |
| 72 | 305 | 0.026 | 0.055 | 521.89 | 305.47 | 429.61 | 299.41 | -.24 | -.19 | .84 |
| 73 | 305 | 0.249 | 0.528 | 521.89 | 305.47 | 429.61 | 299.41 | .09 | .27 | .84 |
| 74 | 305 | 0.278 | 0.815 | 521.89 | 305.47 | 429.61 | 299.41 | .14 | .04 | .84 |
| 75 | 305 | 0.645 | 0.507 | 521.89 | 305.47 | 429.61 | 299.41 | .01 | -.03 | .84 |
| 76 | 305 | 0.619 | 0.293 | 521.89 | 305.47 | 429.61 | 299.41 | -.19 | -.12 | .84 |
| 77 | 305 | 0.808 | 0.382 | 521.89 | 305.47 | 429.61 | 299.41 | -.23 | -.08 | .84 |
| 78 | 305 | 0.088 | 0.134 | 521.89 | 305.47 | 429.61 | 299.41 | -.03 | .04 | .84 |
| 79 | 305 | 0.157 | 0.148 | 521.89 | 305.47 | 429.61 | 299.41 | .15 | .16 | .84 |
| 80 | 305 | 0.011 | 0.036 | 521.89 | 305.47 | 429.61 | 299.41 | -.01 | .12 | .84 |
| 81 | 305 | 0.317 | 0.645 | 521.89 | 305.47 | 429.61 | 299.41 | .03 | .00 | .84 |
| 82 | 305 | 2.489 | 1.595 | 521.89 | 305.47 | 429.61 | 299.41 | -.13 | -.15 | .84 |
| 83 | 305 | 0.408 | 0.487 | 521.89 | 305.47 | 429.61 | 299.41 | -.23 | -.18 | .84 |
| 84 | 305 | 0.347 | 0.330 | 521.89 | 305.47 | 429.61 | 299.41 | -.11 | -.04 | .84 |
| 85 | 305 | 1.105 | 1.247 | 521.89 | 305.47 | 429.61 | 299.41 | -.35 | -.35 | .84 |

TABLE B-1 (Cont'd)

| Cons. No. | No. of Obs. | Av. Conc. | S.D. Conc. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (CxF) | Corr. (CxF) | Corr. (CxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 86 | 305 | 0.075 | 0.399 | 521.89 | 305.25 | 429.61 | 299.41 | .04 | .07 | .84 |
| 87 | 305 | 1.238 | 3.413 | 521.89 | 305.25 | 429.61 | 299.41 | -.13 | -.15 | .84 |
| 88 | 306 | 0.358 | 0.538 | 521.89 | 304.97 | 429.25 | 298.98 | -.10 | .02 | .84 |
| 89 | 306 | 0.765 | 2.130 | 521.89 | 304.97 | 429.25 | 298.98 | -.15 | -.16 | .84 |
| 90 | 306 | 0.418 | 0.984 | 521.89 | 304.97 | 429.25 | 298.98 | -.03 | -.01 | .84 |
| 91 | 304 | 16.861 | 97.166 | 521.89 | 304.97 | 429.25 | 298.98 | .02 | .03 | .84 |
| 92 | 263 | 7.271 | 21.773 | 528.98 | 317.23 | 426.54 | 294.36 | .09 | .10 | .86 |
| 93 | 263 | 3.212 | 7.988 | 528.98 | 317.23 | 426.54 | 294.36 | -.04 | -.03 | .86 |
| 94 | 263 | 12.897 | 19.138 | 528.98 | 317.23 | 426.54 | 294.36 | .07 | -.01 | .86 |
| 95 | 263 | 6.897 | 14.639 | 528.98 | 317.23 | 426.54 | 294.36 | .11 | .16 | .86 |
| 96 | 263 | 13.043 | 38.055 | 528.98 | 317.23 | 426.54 | 294.36 | .07 | .10 | .86 |
| 97 | 263 | 10.044 | 16.151 | 528.98 | 317.23 | 426.54 | 294.36 | .08 | .14 | .86 |
| 98 | 260 | 28.171 | 37.729 | 528.98 | 317.23 | 426.54 | 294.36 | -.33 | -.25 | .86 |
| 99 | 262 | 7.101 | 17.984 | 526.95 | 317.23 | 426.76 | 295.99 | .078 | .12 | .86 |
| 100 | 263 | 2.100 | 3.274 | 529.26 | 317.23 | 426.94 | 294.85 | -.08 | -.04 | .86 |
| 101 | 263 | 1.394 | 4.121 | 528.98 | 317.23 | 426.54 | 294.36 | -.20 | -.21 | .86 |
| 102 | 263 | 1.111 | 3.539 | 528.98 | 317.23 | 426.54 | 294.36 | .03 | .05 | .86 |
| 103 | 263 | 45.644 | 76.187 | 528.98 | 317.23 | 426.54 | 294.36 | -.16 | -.09 | .86 |
| 104 | 263 | 1.724 | 4.611 | 528.98 | 317.23 | 426.54 | 294.36 | .08 | .10 | .86 |
| 105 | 263 | 233.191 | 459.081 | 528.98 | 317.23 | 426.54 | 294.36 | -.35 | -.35 | .86 |
| 106 | 263 | 0.173 | 0.648 | 528.98 | 317.23 | 426.54 | 294.36 | -.10 | -.10 | .86 |
| 107 | 263 | 6.066 | 7.534 | 528.98 | 317.23 | 426.54 | 294.36 | -.03 | -.01 | .86 |
| 108 | 263 | 1.389 | 4.895 | 528.98 | 317.23 | 426.54 | 294.36 | -.11 | -.13 | .86 |
| 109 | 263 | 8.395 | 8.817 | 528.98 | 317.23 | 426.54 | 294.36 | -.08 | -.03 | .86 |
| 110 | 263 | 72.770 | 50.708 | 528.98 | 317.23 | 426.54 | 294.36 | -.24 | -.09 | .86 |
| 111 | 263 | 0.107 | 0.583 | 528.98 | 317.23 | 426.54 | 294.36 | -.05 | -.07 | .86 |
| 112 | 263 | 1.461 | 4.183 | 528.98 | 317.23 | 426.54 | 294.36 | -.04 | -.06 | .86 |
| 113 | 263 | 2.073 | 4.061 | 528.98 | 317.23 | 426.54 | 294.36 | .00 | -.05 | .86 |
| 114* | 719 | 0.000 | 0.000 | 518.01 | 305.40 | 425.66 | 298.83 | .00 | .00 | .84 |
| 115* | 719 | 98.302 | 17.542 | 518.01 | 305.40 | 425.66 | 298.83 | -.66 | -.72 | .84 |
| 116* | 720 | 38.741 | 5.666 | 517.78 | 305.25 | 425.32 | 298.76 | -.69 | -.70 | .84 |
| 117* | 720 | 142.554 | 22.730 | 517.78 | 305.24 | 425.32 | 298.76 | -.67 | -.70 | .84 |
| 118* | 720 | 7.793 | 0.202 | 517.78 | 305.25 | 425.32 | 298.76 | -.53 | -.54 | .84 |
| 119* | 720 | 55.546 | 29.591 | 517.78 | 305.25 | 425.32 | 298.76 | .51 | .62 | .84 |
| 120* | 0 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 121* | 696 | 244.213 | 77.272 | 514.33 | 303.09 | 419.40 | 293.80 | -.25 | -.28 | .85 |
| 122* | 673 | 63.402 | 51.307 | 515.96 | 307.87 | 423.21 | 297.69 | .21 | .33 | .85 |
| 123* | 367 | 2945.970 | 2388.242 | 549.01 | 371.81 | 406.15 | 279.23 | .05 | .03 | .89 |
| 124* | 318 | 12068.613 | 9486.297 | 554.74 | 374.96 | 415.33 | 283.38 | -.39 | -.25 | .89 |
| 125* | 724 | 9.275 | 9.200 | 516.44 | 305.04 | 423.73 | 298.82 | -.22 | -.36 | .84 |
| 126 | 156 | 74.633 | 170.158 | 559.79 | 325.75 | 457.62 | 298.86 | -.09 | .02 | .85 |
| 127 | 153 | 38.255 | 280.064 | 565.20 | 324.96 | 461.62 | 300.28 | .02 | .10 | .84 |
| 128 | 81 | 97.839 | 205.280 | 560.07 | 325.28 | 456.52 | 298.10 | -.28 | -.23 | .85 |
| 129* | 232 | 506.062 | 374.675 | 562.42 | 322.41 | 459.19 | 297.60 | -.18 | -.13 | .84 |
| 130* | 232 | 88.639 | 139.277 | 564.06 | 321.17 | 460.24 | 296.67 | -.13 | -.10 | .84 |

TABLE B-1 (Cont'd)

| Cons. No. | No. of Obs. | Av. Conc. | S.D. Conc. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (CxF) | Corr. (CxF) | Corr. (CxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 131 | 106 | 8.868 | 32.466 | 548.31 | 372.05 | 406.05 | 278.78 | .02 | -.02 | .89 |
| 132 | 102 | 7.608 | 33.274 | 556.45 | 376.99 | 411.38 | 282.64 | .28 | .27 | .89 |
| 133 | 56 | 86.518 | 349.365 | 549.07 | 372.75 | 408.44 | 280.30 | .24 | -.25 | .90 |
| 134 | 105 | 0.915 | 6.639 | 548.31 | 372.05 | 406.05 | 278.78 | -.01 | -.02 | .89 |
| 135 | 102 | 2.029 | 20.496 | 556.45 | 376.99 | 411.38 | 282.64 | .08 | -.08 | .89 |
| 136 | 56 | 0.00 | 0.00 | 549.07 | 372.75 | 408.44 | 280.30 | .00 | .00 | .90 |
| 137 | 156 | 0.022 | 0.032 | 553.44 | 372.42 | 410.37 | 279.62 | -.07 | -.06 | .89 |
| 138 | 156 | 1.439 | 1.036 | 553.44 | 372.42 | 410.37 | 279.62 | .50 | .29 | .89 |
| 139 | 156 | 0.016 | 0.095 | 553.44 | 372.42 | 410.37 | 279.62 | .19 | .18 | .89 |
| 140 | 156 | 0.009 | 0.049 | 553.44 | 372.42 | 410.37 | 279.62 | .30 | .29 | .89 |
| 141 | 156 | 2.941 | 5.544 | 553.44 | 372.42 | 410.37 | 279.62 | -.26 | -.12 | .89 |
| 142 | 156 | 4.678 | 9.921 | 555.88 | 370.87 | 411.94 | 278.42 | .13 | .08 | .89 |
| 143 | 156 | 1.322 | 3.027 | 555.88 | 370.87 | 411.94 | 278.42 | -.09 | -.10 | .89 |
| 144 | 156 | 1.660 | 4.242 | 555.88 | 370.87 | 411.94 | 278.42 | .24 | .31 | .89 |
| 145 | 156 | 0.381 | 1.730 | 555.88 | 370.87 | 411.94 | 278.42 | .09 | .16 | .89 |
| 146 | 156 | 8.330 | 10.650 | 555.88 | 370.87 | 411.94 | 278.42 | -.09 | .04 | .89 |
| 147 | 156 | 27.016 | 29.781 | 555.88 | 370.87 | 411.94 | 278.42 | -.34 | -.36 | .89 |
| 148 | 156 | 3.852 | 4.683 | 555.88 | 370.87 | 411.94 | 278.42 | -.11 | -.01 | .89 |
| 149 | 156 | 35.176 | 35.446 | 555.88 | 370.87 | 411.94 | 278.42 | -.15 | -.06 | .89 |
| 150 | 156 | 8.770 | 11.491 | 555.88 | 370.87 | 411.94 | 278.42 | .06 | .20 | .89 |
| 151 | 156 | 20.638 | 19.420 | 555.88 | 370.87 | 411.94 | 278.42 | -.18 | -.04 | .89 |
| 152 | 156 | 11.685 | 22.268 | 555.88 | 370.87 | 411.94 | 278.42 | -.04 | .06 | .89 |
| 153 | 156 | 9.893 | 23.444 | 555.88 | 370.87 | 411.94 | 278.42 | -.04 | .03 | .89 |
| 154 | 156 | 12.289 | 15.904 | 555.88 | 370.87 | 411.94 | 278.42 | .00 | .15 | .89 |
| 155 | 367 | 918.155 | 1357.074 | 549.01 | 371.81 | 406.15 | 279.23 | .18 | -.16 | .89 |
| 156 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 157 | 51 | 136.765 | 170.950 | 684.51 | 311.35 | 539.41 | 292.63 | -.24 | -.29 | .79 |
| 158 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 159 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 160 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 161 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 162 | 204 | 260.906 | 100.832 | 521.85 | 307.36 | 429.33 | 302.09 | .06 | .01 | .84 |
| 163 | 80 | 334.329 | 100.468 | 551.95 | 318.96 | 449.82 | 293.79 | .25 | .20 | .84 |
| 164 | 209 | 1.381 | 2.210 | 517.69 | 304.82 | 425.40 | 299.62 | -.22 | -.18 | .85 |
| 165 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 166 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 167 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 168 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 169 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 170 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 171 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 172 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |

Note: All concentrations are in ng/L (nanograms/liter) with an exception of those marked with an * (See Appendix A for appropriate units).

TABLE B-2

STATISTICAL ANALYSIS OF MASS FLUX OF POLLUTANTS AT JEFFERSON PARISH

| Cons. No. | No. of Obs. | Av. Load | S.D. Load. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (LxF) | Corr. (LxF) | Corr. (SxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3* | 255 | 0.011 | 0.007 | 513.75 | 289.40 | 431.97 | 302.58 | .95 | .77 | .84 |
| 7 | 209 | 1.798 | 1.539 | 517.69 | 304.82 | 425.40 | 299.62 | .11 | .25 | .85 |
| 8 | 204 | 661.328 | 535.680 | 521.85 | 307.36 | 429.33 | 302.09 | .85 | .67 | .84 |
| 9 | 80 | 968.271 | 772.974 | 551.95 | 318.96 | 449.82 | 293.79 | .87 | .72 | .84 |
| 10 | 52 | 11.433 | 10.998 | 391.54 | 196.85 | 330.79 | 286.61 | .50 | .42 | .88 |
| 11 | 209 | 0.124 | 0.484 | 517.69 | 304.82 | 425.40 | 299.62 | -.06 | -.03 | .85 |
| 12 | 204 | 72.540 | 36.051 | 521.85 | 307.36 | 429.33 | 302.09 | .69 | .51 | .84 |
| 13 | 80 | 61.544 | 41.790 | 551.95 | 318.96 | 449.82 | 293.79 | .54 | .36 | .84 |
| 14 | 52 | 0.498 | 1.601 | 391.54 | 196.85 | 330.79 | 286.61 | .30 | .25 | .88 |
| 15 | 209 | 1.152 | 5.659 | 517.69 | 304.82 | 425.40 | 299.62 | .03 | .03 | .85 |
| 16 | 204 | 10.055 | 8.803 | 521.85 | 307.36 | 429.33 | 302.09 | -.11 | -.08 | .84 |
| 17 | 80 | 8.934 | 6.423 | 551.95 | 318.96 | 449.82 | 293.79 | .12 | .08 | .84 |
| 18 | 52 | 5.025 | 12.564 | 391.54 | 196.85 | 330.79 | 286.61 | .32 | .24 | .88 |
| 19 | 209 | 0.000 | 0.000 | 517.69 | 304.82 | 425.40 | 299.62 | .00 | .00 | .85 |
| 20 | 204 | 0.099 | 0.282 | 521.85 | 307.36 | 429.33 | 302.09 | -.06 | -.03 | .84 |
| 21 | 80 | 0.225 | 0.640 | 551.95 | 318.96 | 449.82 | 293.79 | -.18 | -.20 | .84 |
| 22 | 52 | 0.000 | 0.000 | 391.54 | 196.85 | 330.79 | 286.61 | .00 | .00 | .88 |
| 23 | 209 | 7.303 | 8.465 | 517.69 | 304.82 | 425.40 | 299.62 | -.04 | .03 | .85 |
| 24 | 204 | 7.834 | 8.212 | 521.85 | 307.36 | 429.33 | 302.09 | .04 | .12 | .84 |
| 25 | 80 | 4.101 | 3.341 | 551.95 | 318.96 | 449.82 | 293.79 | .08 | .05 | .84 |
| 26 | 52 | 15.185 | 9.943 | 391.54 | 196.85 | 330.79 | 286.61 | .37 | .26 | .88 |
| 27 | 103 | 0.557 | 1.249 | 486.18 | 212.15 | 445.32 | 319.79 | .09 | .07 | .93 |
| 28 | 102 | 0.720 | 1.472 | 487.24 | 212.92 | 447.28 | 320.75 | .12 | .09 | .93 |
| 29 | 25 | 1.656 | 1.723 | 584.72 | 182.67 | 564.16 | 314.16 | .00 | .08 | .97 |
| 30 | 52 | 0.289 | 0.384 | 391.54 | 196.85 | 330.79 | 286.61 | .19 | .19 | .88 |
| 31 | 103 | 0.117 | 0.293 | 486.18 | 212.92 | 445.32 | 319.79 | .19 | .19 | .93 |
| 32 | 102 | 0.127 | 0.222 | 487.24 | 212.92 | 447.28 | 320.75 | .13 | .08 | .93 |
| 33 | 25 | 0.236 | 0.205 | 584.72 | 182.67 | 564.16 | 314.16 | .10 | .16 | .99 |
| 34 | 52 | 0.106 | 0.370 | 391.54 | 196.85 | 330.79 | 286.61 | .14 | .06 | .88 |
| 35 | 209 | 0.528 | 1.474 | 517.69 | 304.82 | 425.40 | 299.62 | .27 | .22 | .85 |
| 36 | 204 | 0.597 | 2.143 | 521.85 | 307.36 | 429.33 | 302.08 | .10 | .14 | .84 |
| 37 | 80 | 0.785 | 2.250 | 551.95 | 318.96 | 449.82 | 293.79 | .16 | .44 | .84 |
| 38 | 52 | 0.242 | 0.422 | 391.54 | 196.85 | 330.79 | 286.61 | .11 | .21 | .88 |
| 39 | 209 | 0.315 | 0.747 | 517.69 | 304.82 | 425.40 | 299.62 | -.15 | -.15 | .85 |
| 40 | 204 | 0.336 | 0.660 | 521.85 | 307.36 | 429.33 | 302.09 | -.08 | -.11 | .84 |
| 41 | 80 | 0.442 | 0.872 | 551.95 | 318.96 | 449.82 | 293.79 | .20 | .23 | .84 |
| 42 | 52 | 0.298 | 0.650 | 391.54 | 196.85 | 330.79 | 286.61 | -.11 | -.17 | .88 |
| 43 | 209 | 0.496 | 1.632 | 517.69 | 304.82 | 425.40 | 299.62 | -.04 | .04 | .85 |
| 44 | 204 | 0.323 | 0.718 | 521.85 | 307.36 | 429.33 | 302.09 | .08 | .14 | .84 |
| 45 | 80 | 0.163 | 0.192 | 551.95 | 318.96 | 449.82 | 293.79 | .09 | .30 | .84 |
| 46 | 52 | 0.588 | 1.579 | 391.54 | 196.85 | 330.79 | 286.61 | .13 | .22 | .88 |
| 47 | 209 | 1.340 | 3.169 | 517.69 | 304.82 | 425.40 | 299.62 | -.12 | -.05 | .85 |
| 48 | 204 | 1.695 | 3.596 | 521.85 | 307.35 | 429.33 | 302.09 | -.05 | .00 | .84 |
| 49 | 81 | 5.205 | 10.022 | 365.51 | 186.82 | 317.00 | 265.16 | .21 | .17 | .89 |
| 50 | 209 | 0.129 | 0.329 | 517.69 | 304.82 | 425.40 | 299.62 | -.04 | .03 | .85 |

TABLE B-2 (Cont'd)

| Cons. No. | No. of Obs. | Av. Load | S.D. Load. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (LxF) | Corr. (LxF) | Corr. (SxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 204 | 0.895 | 3.088 | 521.85 | 307.36 | 429.33 | 302.09 | .02 | .10 | .84 |
| 52 | 80 | 4.537 | 14.073 | 551.95 | 318.96 | 449.82 | 293.79 | .06 | .09 | .84 |
| 53 | 52 | 7.904 | 11.683 | 391.54 | 196.85 | 330.79 | 286.61 | .17 | .17 | .88 |
| 54 | 209 | 0.000 | 0.000 | 517.69 | 304.82 | 425.40 | 299.62 | .00 | .00 | .85 |
| 55 | 204 | 0.009 | 0.104 | 521.85 | 307.36 | 429.33 | 302.09 | -.02 | .00 | .84 |
| 56 | 80 | 0.000 | 0.000 | 551.95 | 318.96 | 449.82 | 293.79 | .00 | .00 | .84 |
| 57 | 52 | 0.000 | 0.000 | 391.54 | 196.85 | 330.79 | 286.61 | .00 | .00 | .88 |
| 58 | 209 | 0.020 | 0.162 | 517.69 | 304.82 | 425.40 | 299.62 | -.11 | -.13 | .85 |
| 59 | 204 | 0.099 | 0.349 | 521.85 | 307.36 | 429.33 | 302.09 | .12 | .12 | .84 |
| 60 | 80 | 0.013 | 0.120 | 551.95 | 318.96 | 449.82 | 293.79 | -.05 | -.05 | .84 |
| 61 | 52 | 0.054 | 0.261 | 391.54 | 196.85 | 330.79 | 286.61 | -.19 | -.19 | .88 |
| 62 | 209 | 0.010 | 0.136 | 517.69 | 304.82 | 425.40 | 299.62 | -.08 | -.09 | .85 |
| 63 | 204 | 0.000 | 0.000 | 521.85 | 307.36 | 429.33 | 302.09 | .00 | .00 | .84 |
| 64 | 80 | 0.000 | 0.000 | 551.95 | 318.96 | 449.82 | 293.79 | .00 | .00 | .84 |
| 65 | 52 | 0.000 | 0.000 | 391.54 | 196.85 | 330.79 | 286.61 | .00 | .00 | .88 |
| 66 | 304 | 0.005 | 0.004 | 522.83 | 305.52 | 430.64 | 299.35 | .78 | .76 | .88 |
| 67 | 305 | 0.006 | 0.013 | 521.89 | 305.47 | 429.61 | 299.41 | .62 | .30 | .88 |
| 68 | 305 | 0.003 | 0.002 | 521.89 | 305.47 | 429.61 | 299.41 | .59 | .59 | .88 |
| 69 | 305 | 0.002 | 0.003 | 521.89 | 305.47 | 429.61 | 299.41 | .27 | .19 | .88 |
| 70 | 305 | 0.000 | 0.001 | 521.89 | 305.47 | 429.61 | 299.41 | .40 | .29 | .88 |
| 71 | 305 | 0.000 | 0.000 | 521.89 | 305.47 | 429.61 | 299.41 | -.08 | .06 | .88 |
| 72 | 305 | 0.000 | 0.000 | 521.89 | 305.47 | 429.61 | 299.41 | -.10 | .00 | .88 |
| 73 | 305 | 0.001 | 0.002 | 521.37 | 305.84 | 428.96 | 299.69 | .24 | .45 | .88 |
| 74 | 305 | 0.001 | 0.003 | 521.89 | 305.47 | 429.61 | 299.41 | .34 | .16 | .88 |
| 75 | 305 | 0.002 | 0.002 | 521.89 | 305.47 | 429.61 | 299.41 | .69 | .51 | .88 |
| 76 | 305 | 0.002 | 0.001 | 521.89 | 305.47 | 429.61 | 299.41 | .68 | .64 | .88 |
| 77 | 305 | 0.002 | 0.001 | 521.89 | 305.47 | 429.61 | 299.41 | .63 | .69 | .88 |
| 78 | 305 | 0.000 | 0.000 | 521.89 | 305.47 | 429.61 | 299.41 | .28 | .30 | .88 |
| 79 | 305 | 0.000 | 0.001 | 521.89 | 305.47 | 429.61 | 299.41 | .54 | .45 | .88 |
| 80 | 305 | 0.000 | 0.000 | 521.89 | 305.47 | 429.61 | 299.41 | .13 | .37 | .88 |
| 81 | 305 | 0.001 | 0.002 | 521.89 | 305.47 | 429.61 | 299.41 | .31 | .22 | .88 |
| 82 | 305 | 0.007 | 0.005 | 521.89 | 305.47 | 429.61 | 299.41 | .68 | .52 | .88 |
| 83 | 305 | 0.001 | 0.001 | 521.89 | 305.47 | 429.61 | 299.41 | .09 | .12 | .88 |
| 84 | 305 | 0.001 | 0.001 | 521.89 | 305.47 | 429.61 | 299.41 | .27 | .31 | .88 |
| 85 | 305 | 0.002 | 0.002 | 521.89 | 305.47 | 429.62 | 299.41 | -.01 | -.04 | .88 |
| 86 | 305 | 0.000 | 0.001 | 521.89 | 305.47 | 429.61 | 299.41 | .07 | .10 | .88 |
| 87 | 305 | 0.003 | 0.006 | 521.89 | 305.47 | 429.61 | 299.41 | .09 | .05 | .88 |
| 88 | 306 | 0.001 | 0.001 | 521.85 | 304.97 | 429.25 | 298.98 | .12 | .30 | .88 |
| 89 | 306 | 0.002 | 0.005 | 521.85 | 304.97 | 429.25 | 298.98 | .00 | .00 | .88 |
| 90 | 306 | 0.001 | 0.003 | 521.85 | 304.97 | 429.25 | 298.98 | .18 | .22 | .88 |
| 91 | 306 | 0.050 | 0.295 | 521.85 | 304.97 | 429.25 | 298.98 | .06 | .07 | .84 |
| 92 | 263 | 0.024 | 0.054 | 528.98 | 317.23 | 426.54 | 294.36 | .25 | .25 | .86 |
| 93 | 263 | 0.009 | 0.023 | 528.98 | 317.23 | 426.54 | 294.36 | .04 | .05 | .86 |
| 94 | 263 | 0.039 | 0.056 | 528.98 | 317.23 | 426.54 | 294.36 | .41 | .25 | .86 |
| 95 | 263 | 0.022 | 0.054 | 528.98 | 317.23 | 426.54 | 294.36 | .23 | .26 | .86 |

TABLE B-2 (Cont'd)

| Cons. No. | No. of Obs. | Av. Load | S.D. Load. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (LxF) | Corr. (LxF) | Corr. (SxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 96 | 263 | 0.042 | 0.134 | 528.98 | 317.23 | 426.54 | 294.36 | .15 | .17 | .86 |
| 97 | 263 | 0.031 | 0.061 | 528.98 | 317.23 | 426.54 | 294.36 | .27 | .30 | .86 |
| 98 | 263 | 0.059 | 0.069 | 528.98 | 317.23 | 426.54 | 294.36 | .00 | .09 | .86 |
| 99 | 260 | 0.022 | 0.071 | 526.83 | 317.99 | 426.76 | 295.99 | .26 | .27 | .86 |
| 100 | 262 | 0.006 | 0.009 | 529.26 | 317.80 | 426.94 | 294.85 | .19 | .22 | .86 |
| 101 | 263 | 0.003 | 0.008 | 528.98 | 317.23 | 426.54 | 294.36 | -.09 | -.12 | .86 |
| 102 | 263 | 0.003 | 0.011 | 528.98 | 317.23 | 426.54 | 294.36 | .12 | .15 | .86 |
| 103 | 263 | 0.109 | 0.138 | 528.98 | 317.23 | 426.54 | 294.36 | .11 | .20 | .86 |
| 104 | 263 | 0.006 | 0.018 | 528.98 | 317.23 | 426.54 | 294.36 | .18 | .19 | .86 |
| 105 | 263 | 0.391 | 0.691 | 528.98 | 317.23 | 426.54 | 294.36 | -.28 | -.29 | .86 |
| 106 | 263 | 0.000 | 0.001 | 528.98 | 317.23 | 426.54 | 294.36 | -.01 | -.02 | .86 |
| 107 | 263 | 0.017 | 0.026 | 528.98 | 317.23 | 426.54 | 294.36 | .28 | .26 | .86 |
| 108 | 263 | 0.003 | 0.010 | 528.98 | 317.23 | 426.54 | 294.36 | -.01 | -.03 | .86 |
| 109 | 263 | 0.023 | 0.023 | 528.98 | 317.23 | 426.54 | 294.36 | .35 | .39 | .86 |
| 110 | 263 | 0.187 | 0.134 | 528.98 | 317.23 | 426.54 | 294.36 | .43 | .56 | .86 |
| 111 | 263 | 0.000 | 0.001 | 528.98 | 317.23 | 426.54 | 294.36 | -.02 | -.04 | .86 |
| 112 | 263 | 0.004 | 0.009 | 528.98 | 317.23 | 426.54 | 294.36 | .08 | .05 | .86 |
| 113 | 263 | 0.006 | 0.011 | 528.98 | 317.23 | 426.54 | 294.36 | .14 | .08 | .86 |
| 114* | 719 | 0.000 | 0.000 | 518.01 | 305.40 | 425.66 | 298.83 | .00 | .00 | .84 |
| 115* | 719 | 0.256 | 0.127 | 518.01 | 305.40 | 425.66 | 298.83 | .97 | .76 | .84 |
| 116 | 720 | 0.102 | 0.051 | 517.78 | 305.25 | 425.32 | 298.76 | .98 | .80 | .84 |
| 117* | 720 | 0.373 | 0.187 | 517.78 | 305.25 | 425.32 | 298.76 | .98 | .78 | .84 |
| 120* | 0 | 0.000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 121* | 696 | 0.646 | 0.392 | 514.33 | 303.09 | 419.40 | 293.80 | .87 | .69 | .85 |
| 122* | 673 | 0.194 | 0.198 | 515.96 | 307.87 | 423.21 | 297.69 | .71 | .72 | .85 |
| 126 | 156 | 0.198 | 0.525 | 559.79 | 323.75 | 457.62 | 298.86 | .17 | .31 | .85 |
| 127 | 153 | 0.125 | 1.081 | 565.20 | 324.96 | 461.62 | 300.28 | .04 | .13 | .84 |
| 128 | 81 | 0.194 | 0.441 | 560.07 | 325.28 | 456.52 | 298.10 | -.09 | -.03 | .85 |
| 131 | 106 | 0.027 | 0.112 | 548.31 | 372.05 | 406.05 | 278.78 | .29 | .25 | .89 |
| 132 | 102 | 0.042 | 0.214 | 556.45 | 376.99 | 411.38 | 282.64 | .35 | .34 | .89 |
| 133 | 56 | 0.089 | 0.257 | 549.07 | 372.75 | 408.46 | 280.30 | -.17 | -.17 | .90 |
| 134 | 106 | 0.003 | 0.019 | 548.31 | 372.05 | 406.05 | 278.78 | -.01 | -.01 | .89 |
| 135 | 102 | 0.003 | 0.028 | 556.45 | 376.99 | 411.38 | 282.64 | -.08 | -.08 | .89 |
| 136 | 56 | 0.000 | 0.000 | 549.07 | 372.75 | 408.46 | 280.30 | .00 | .00 | .90 |
| 137 | 156 | 0.000 | 0.000 | 553.44 | 372.42 | 410.37 | 279.62 | .26 | .23 | .89 |
| 138 | 156 | 0.005 | 0.007 | 553.44 | 372.42 | 410.37 | 279.62 | .81 | .59 | .89 |
| 139 | 156 | 0.000 | 0.000 | 553.44 | 372.42 | 410.37 | 279.62 | .26 | .24 | .89 |
| 140 | 156 | 0.000 | 0.000 | 553.44 | 372.42 | 410.37 | 279.62 | .36 | .32 | .89 |
| 141 | 156 | 0.006 | 0.013 | 553.44 | 372.42 | 410.37 | 279.62 | .05 | .09 | .89 |
| 142 | 156 | 0.017 | 0.033 | 555.88 | 370.87 | 411.94 | 278.42 | .39 | .33 | .89 |
| 143 | 156 | 0.003 | 0.007 | 555.88 | 370.87 | 411.94 | 278.42 | -.01 | -.02 | .89 |
| 144 | 156 | 0.007 | 0.019 | 555.88 | 370.87 | 411.94 | 278.42 | .40 | .46 | .89 |
| 145 | 156 | 0.001 | 0.006 | 555.88 | 370.87 | 411.94 | 278.42 | .18 | .26 | .89 |
| 146 | 156 | 0.023 | 0.038 | 555.88 | 370.87 | 411.94 | 278.42 | .42 | .51 | .89 |
| 147 | 156 | 0.061 | 0.059 | 555.88 | 370.87 | 411.94 | 278.42 | .25 | .16 | .89 |
| 148 | 156 | 0.011 | 0.016 | 555.88 | 370.87 | 411.94 | 278.42 | .39 | .46 | .89 |
| 149 | 156 | 0.095 | 0.110 | 555.88 | 370.87 | 411.94 | 278.42 | .46 | .52 | .89 |
| 150 | 156 | 0.028 | 0.054 | 555.88 | 370.87 | 411.94 | 278.42 | .38 | .48 | .89 |

TABLE B-2 (Cont'd)

| Cons. No. | No. of Obs. | Av. Load | S.D. Load. | Av. Flow | S.D. Flow | Avg. S.S. | S.D. S.S. | Corr. (LxF) | Corr. (LxF) | Corr. (SxF) |
|---|---|---|---|---|---|---|---|---|---|---|
| 151 | 156 | 0.055 | 0.065 | 555.88 | 370.87 | 411.94 | 278.42 | .38 | .49 | .89 |
| 152 | 156 | 0.033 | 0.060 | 555.88 | 370.87 | 411.94 | 278.42 | .35 | .46 | .89 |
| 153 | 156 | 0.028 | 0.047 | 555.88 | 370.87 | 411.94 | 278.42 | .37 | .47 | .89 |
| 154 | 156 | 0.037 | 0.053 | 555.88 | 370.87 | 411.94 | 278.42 | .38 | .50 | .89 |
| 156* | 0 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 | .00 | .00 | .00 |
| 157 | 51 | 0.439 | 0.486 | 684.51 | 311.35 | 539.41 | 292.63 | .17 | -.01 | .79 |
| 162# | 204 | 0.744 | 0.564 | 521.85 | 307.36 | 429.33 | 302.09 | .85 | .67 | .84 |
| 163# | 80 | 1.039 | 0.801 | 551.95 | 318.96 | 449.82 | 293.79 | .87 | .72 | .84 |
| 164# | 209 | 0.033 | 0.006 | 517.69 | 304.82 | 425.40 | 299.62 | .05 | .09 | .85 |

NOTE: All loads are in pounds per day with the exception of constituents marked with # = 1000 pounds/day and * = 1,000,000 pounds/day.

# APPENDIX C

## DOWNSTREAM-DIRECTED INFLUENCE LINE PROFILES

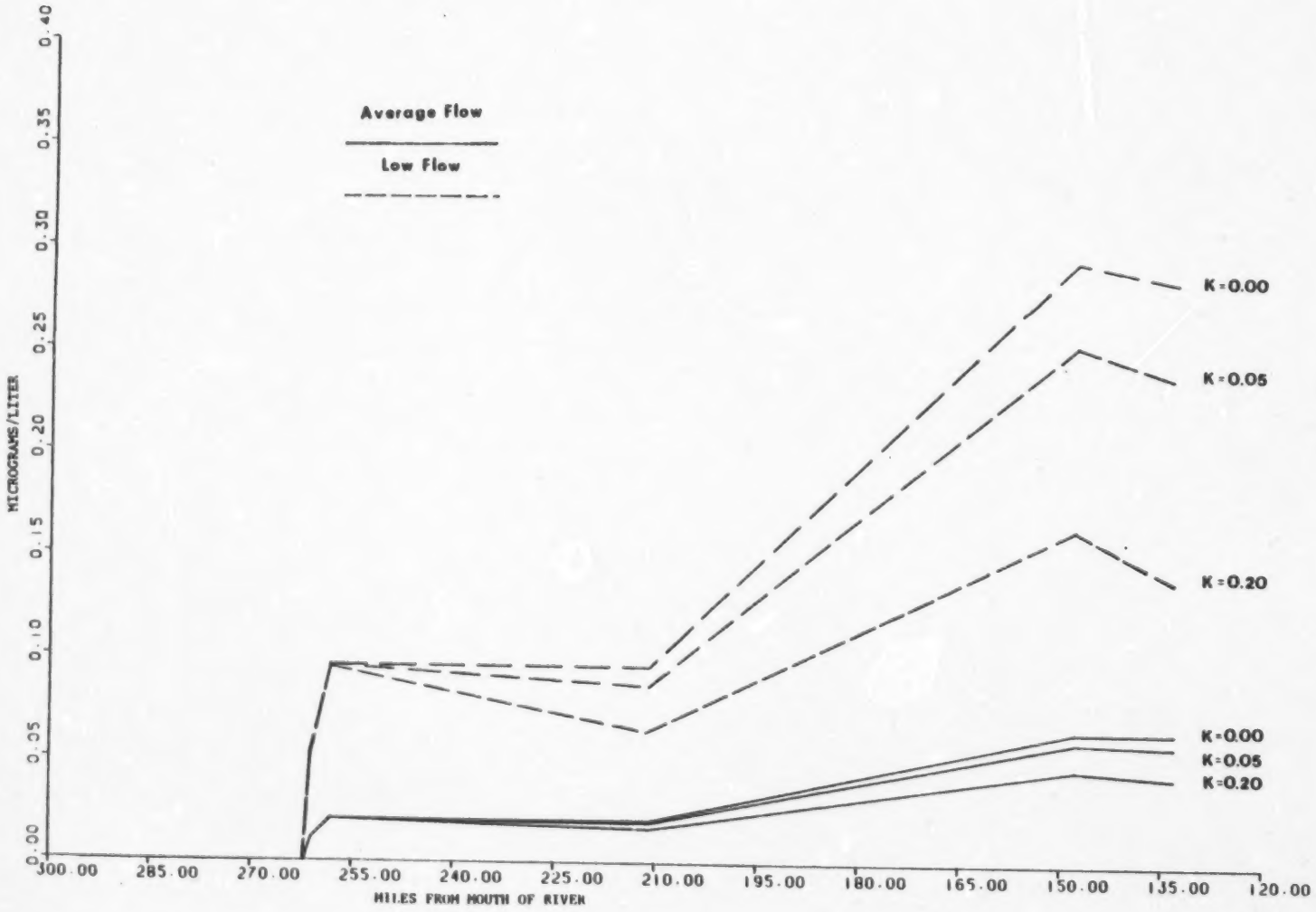



FIGURE C-1. CONCENTRATION PROFILES FOR DICHLOROMETHANE

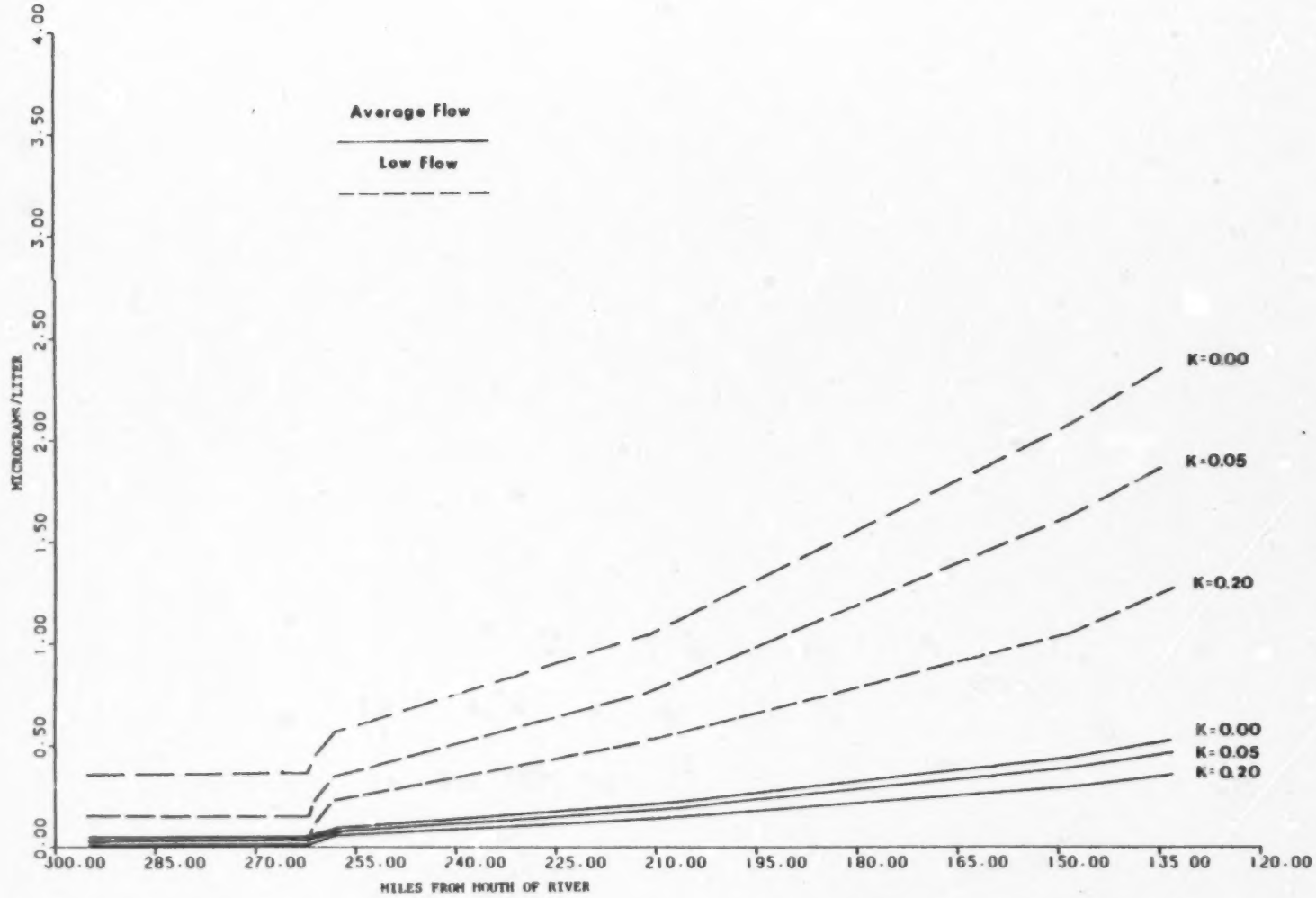



FIGURE C-2. CONCENTRATION PROFILES FOR CHLOROFORM

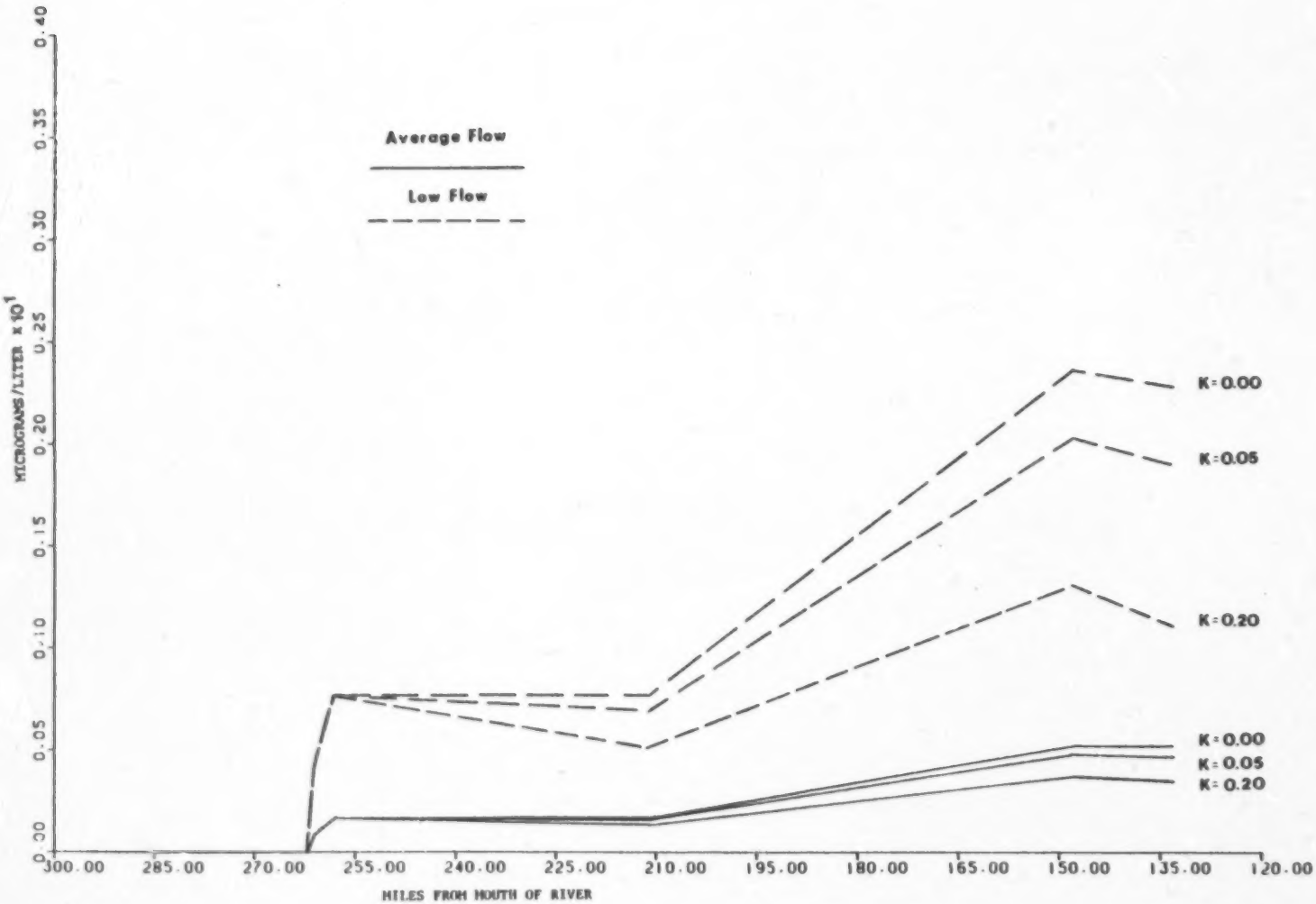



FIGURE C-3. CONCENTRATION PROFILES FOR CARBON TETRACHLORIDE

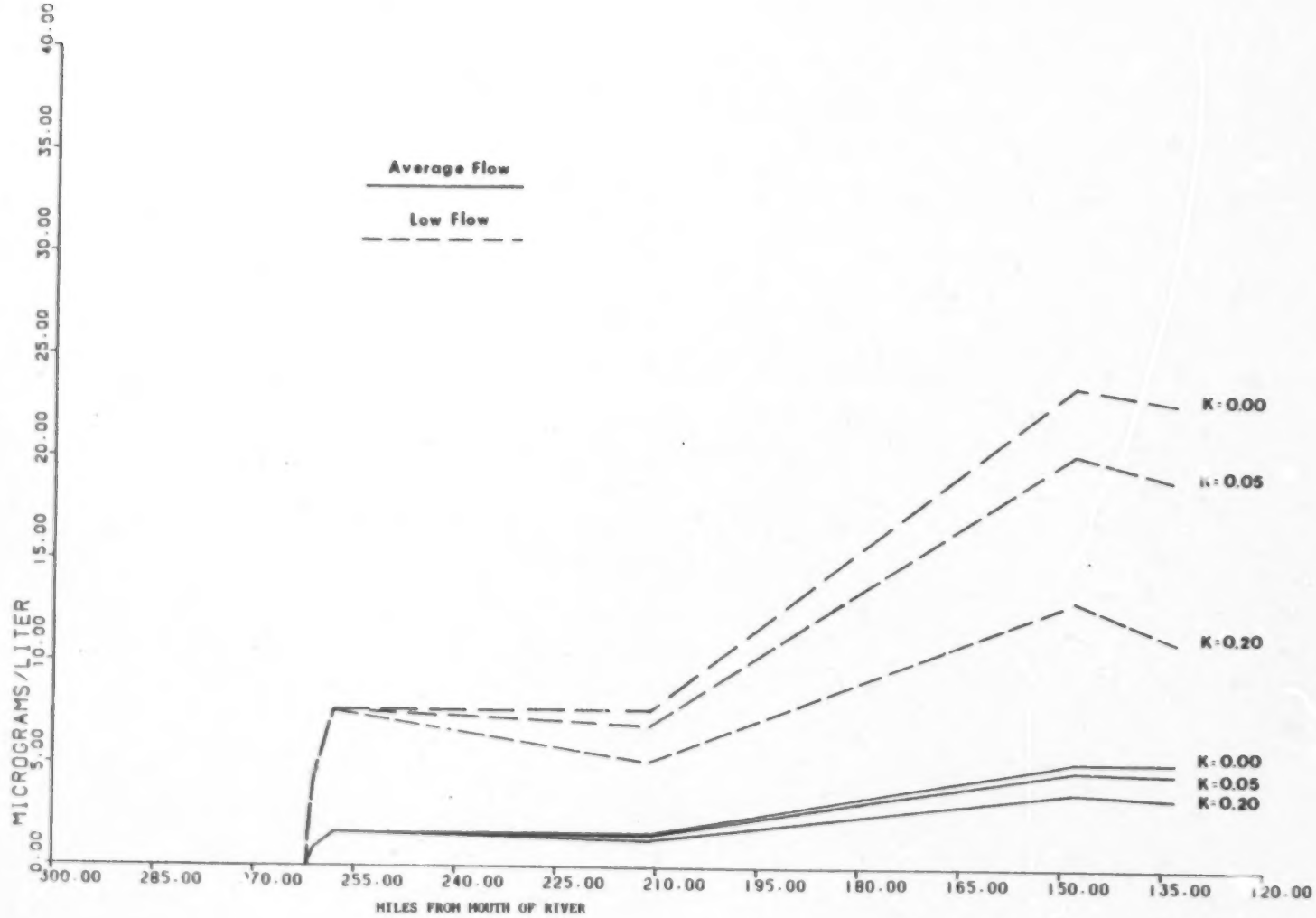



FIGURE C-4. CONCENTRATION PROFILES FOR DICHLOROETHANE

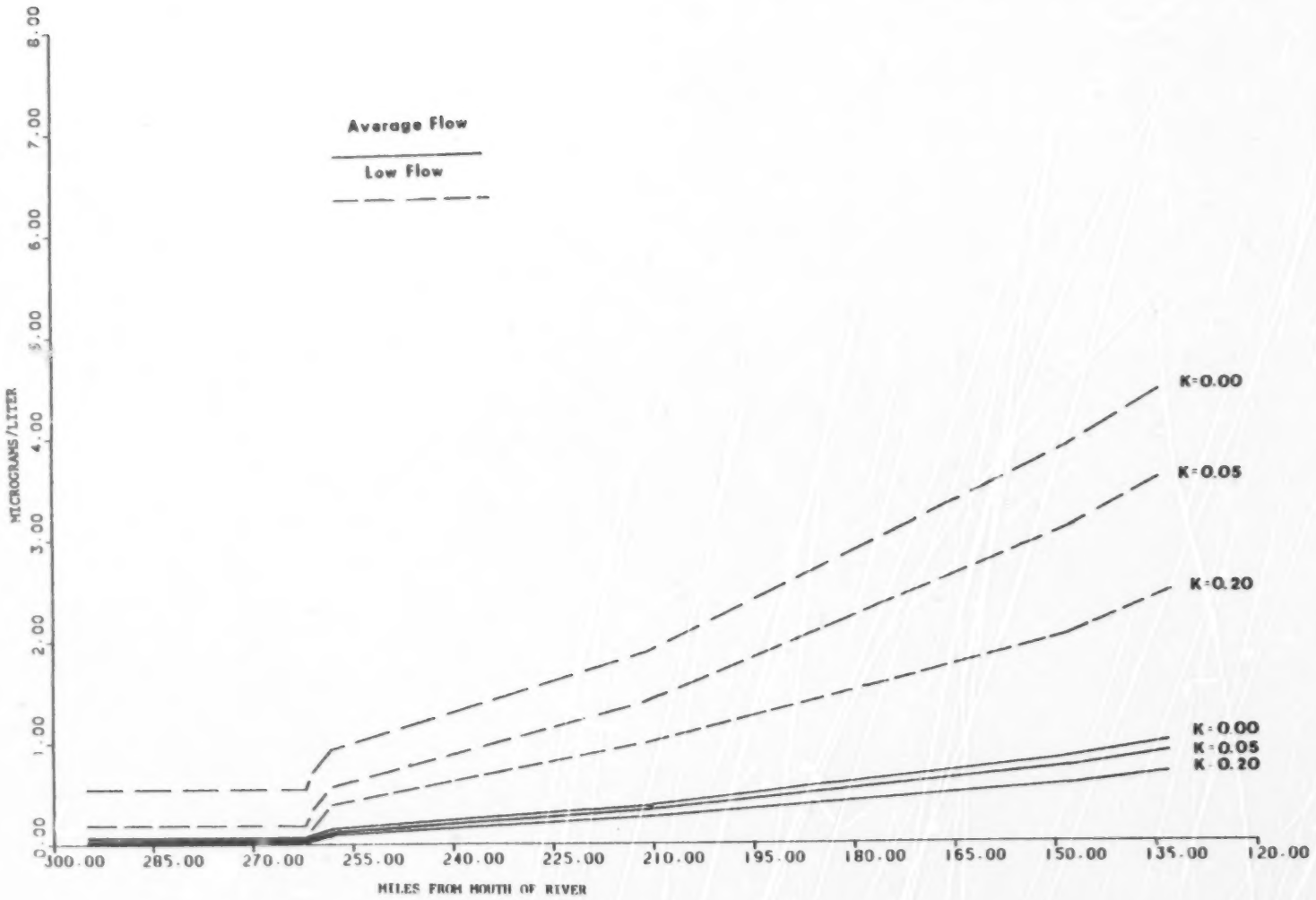



FIGURE C-5. CONCENTRATION PROFILES FOR TRICHLOROETHENE

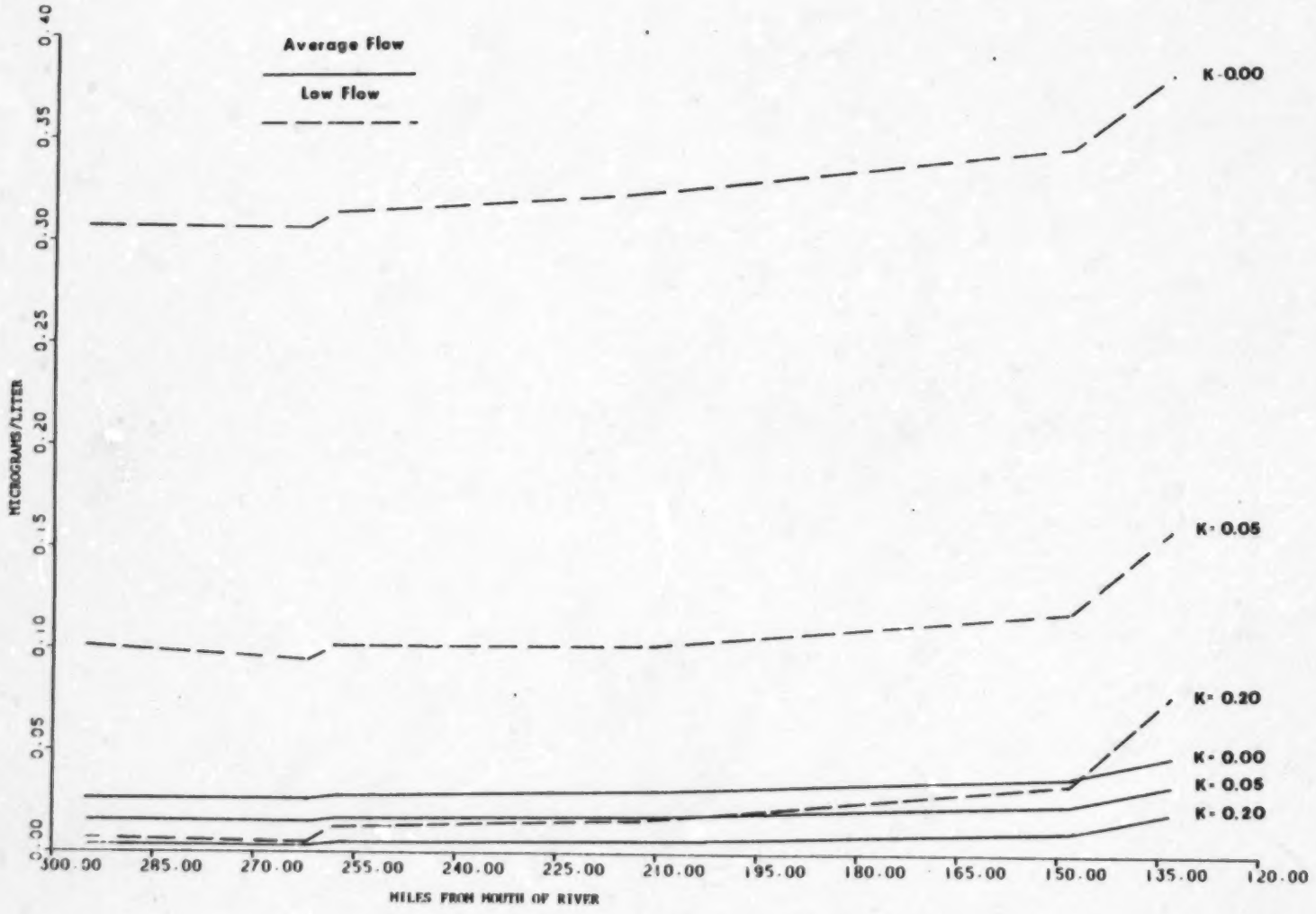



FIGURE C-6. CONCENTRATION PROFILES FOR TETRACHLOROETHENE

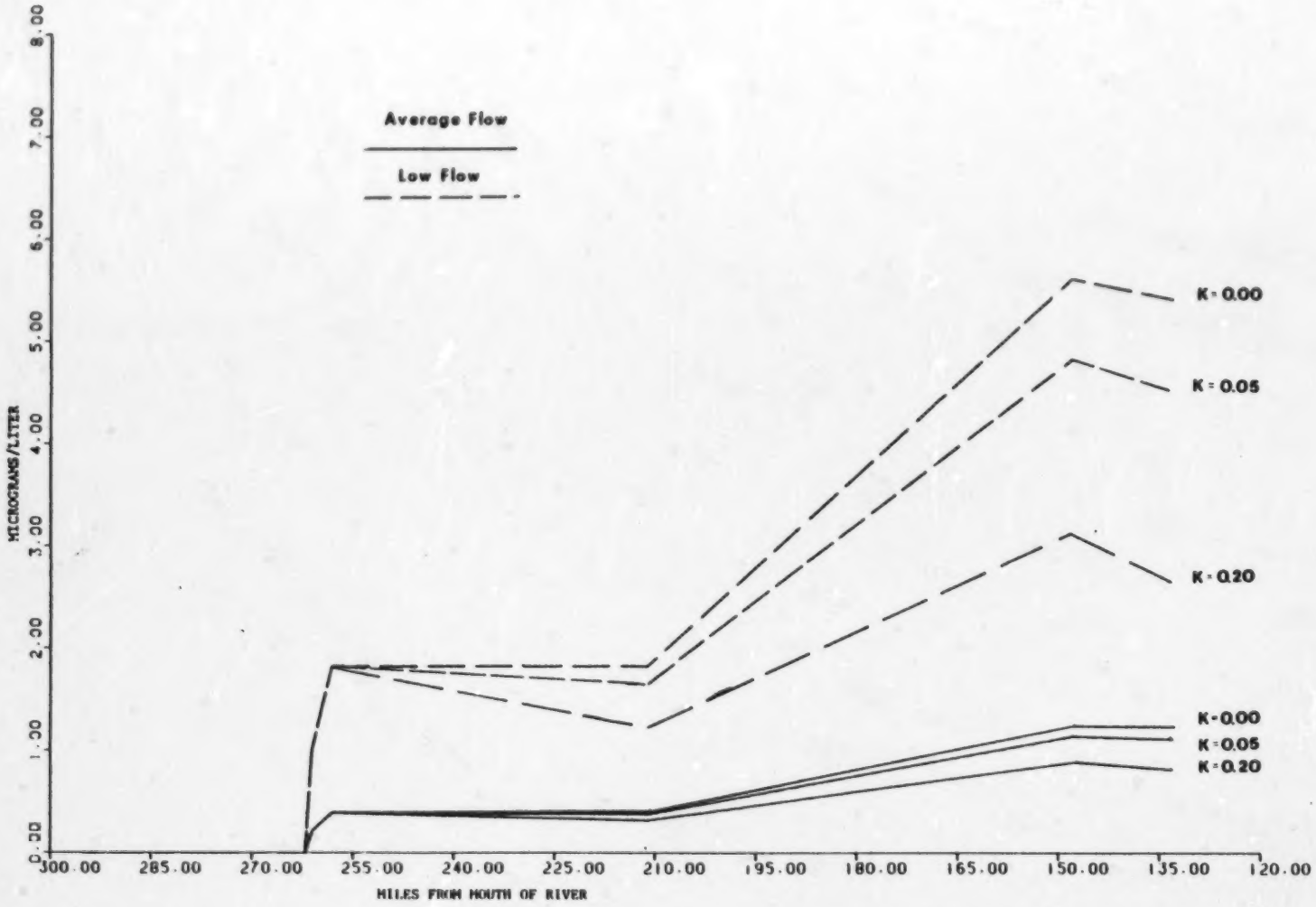



FIGURE C-7. CONCENTRATION PROFILES FOR BENZENE

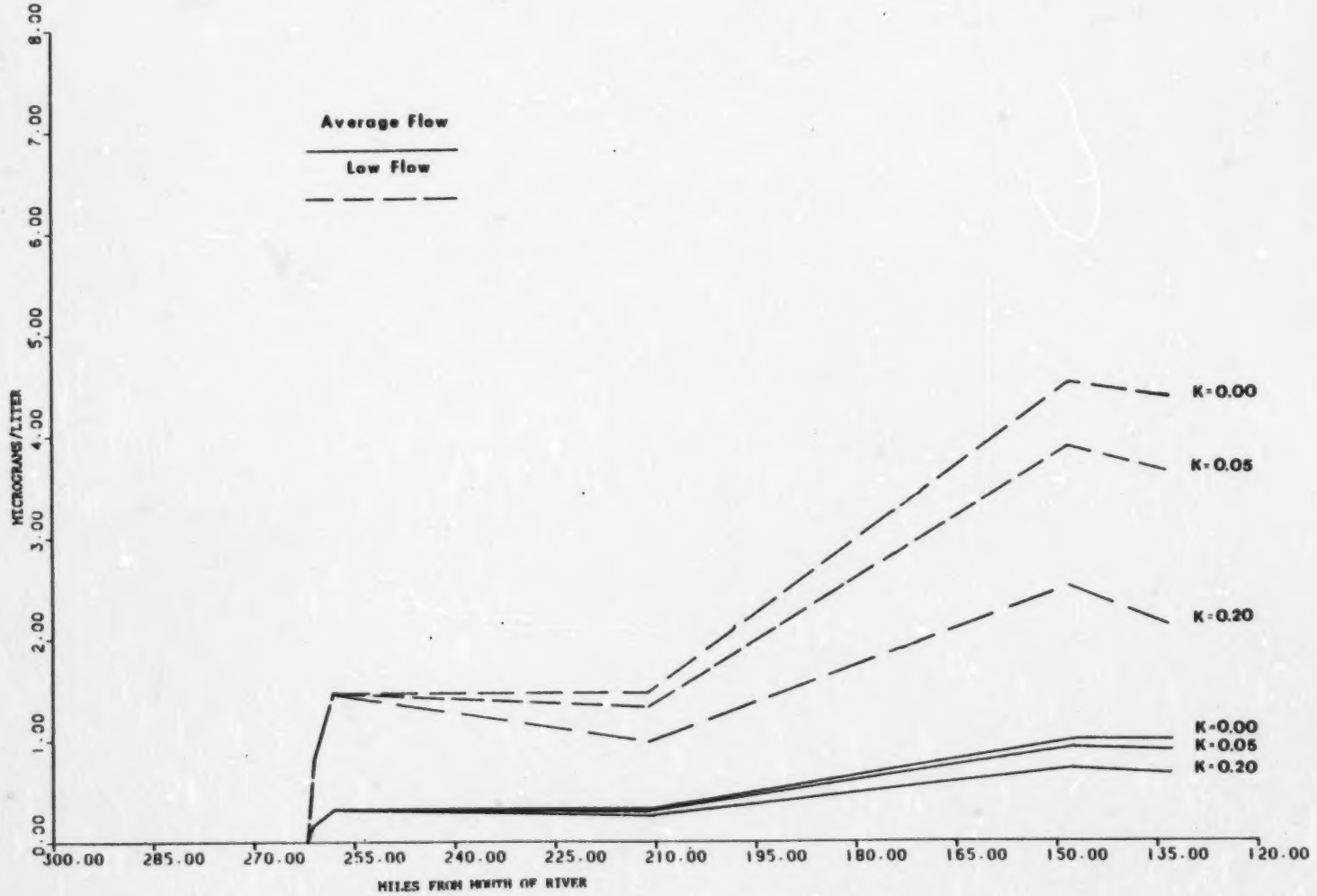



FIGURE C-8. CONCENTRATION PROFILES FOR TOLUENE

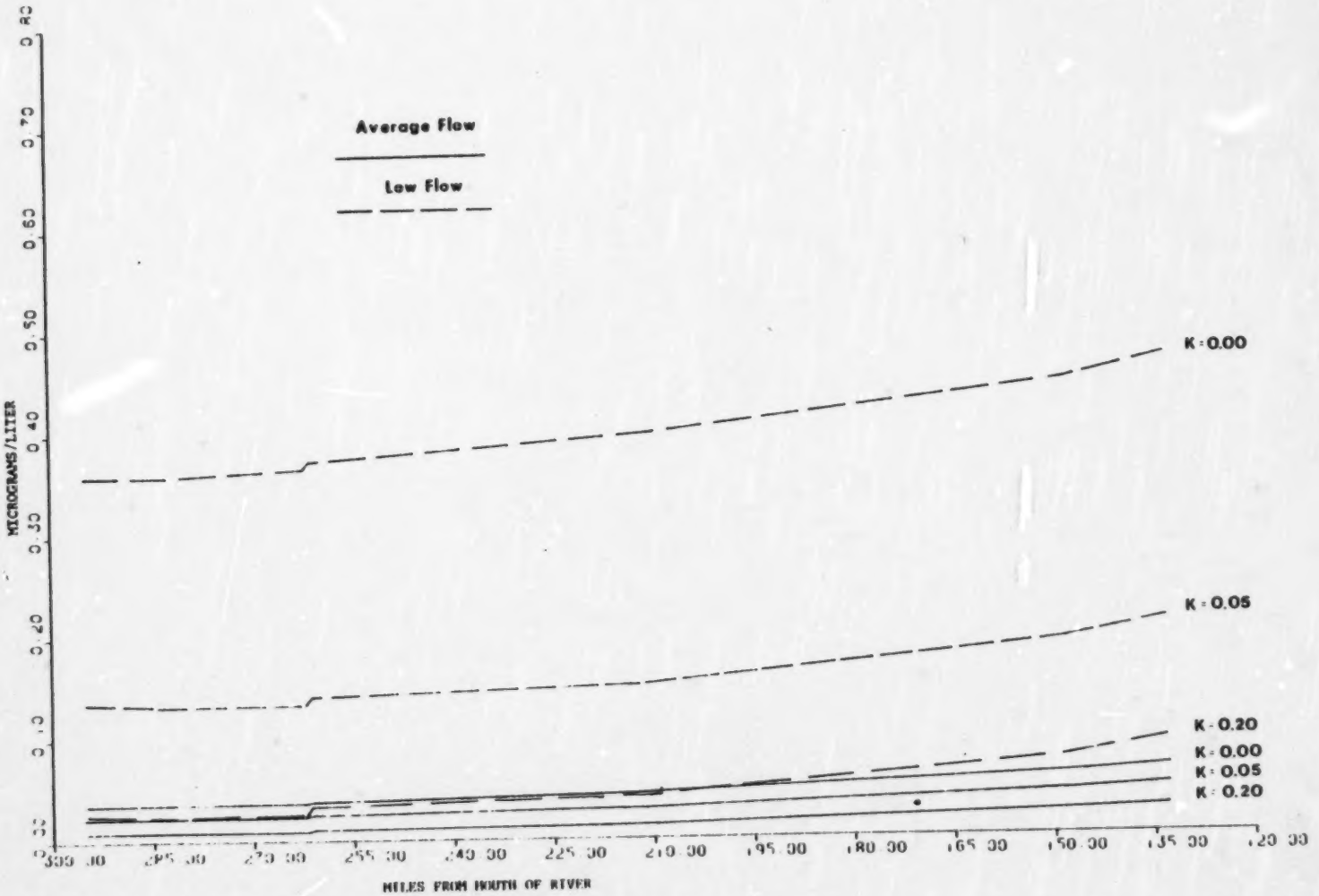



FIGURE C-9. CONCENTRATION PROFILES FOR BIS (2-ETHYL HEXYL) PHTHALATE

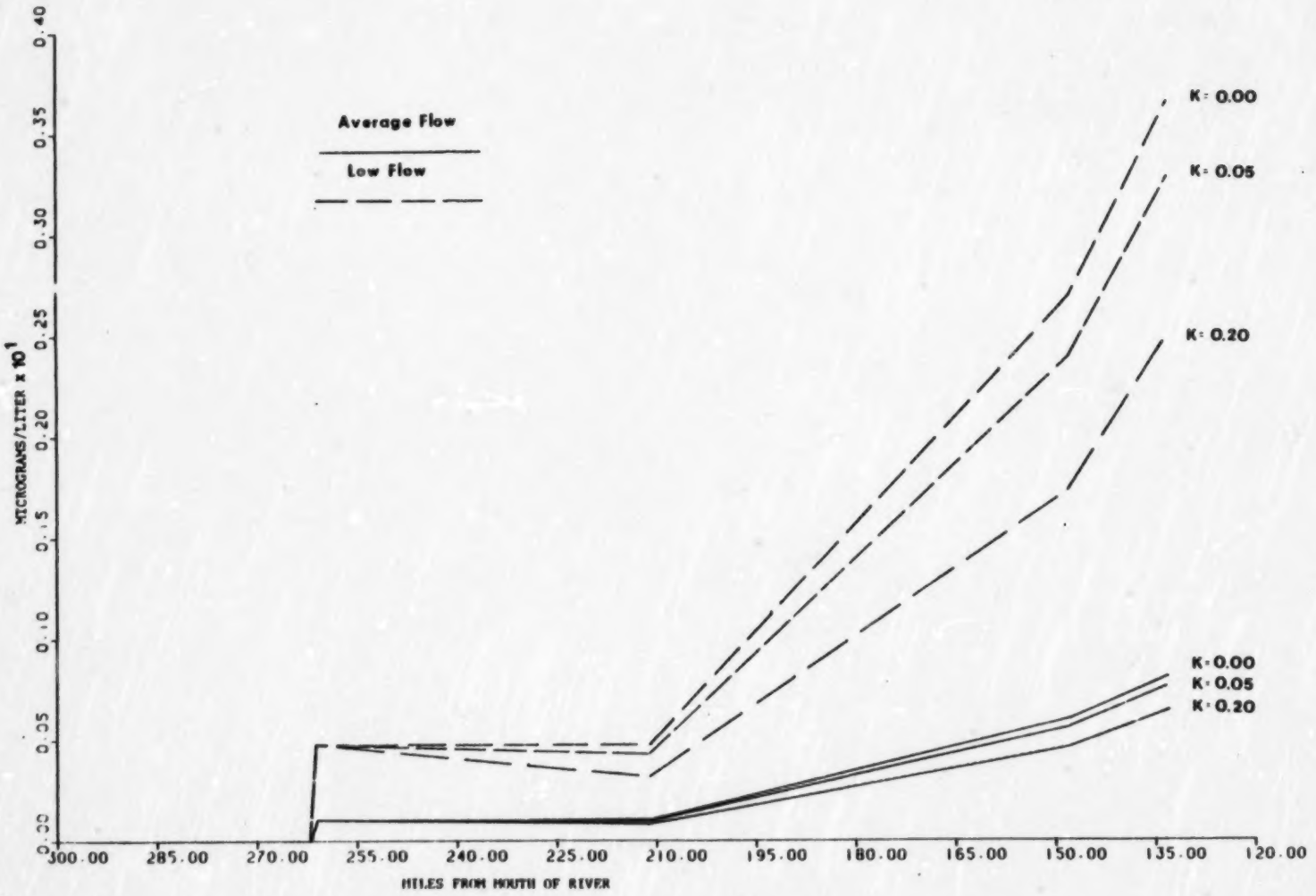



FIGURE C-10. CONCENTRATION PROFILES FOR FLUORENE

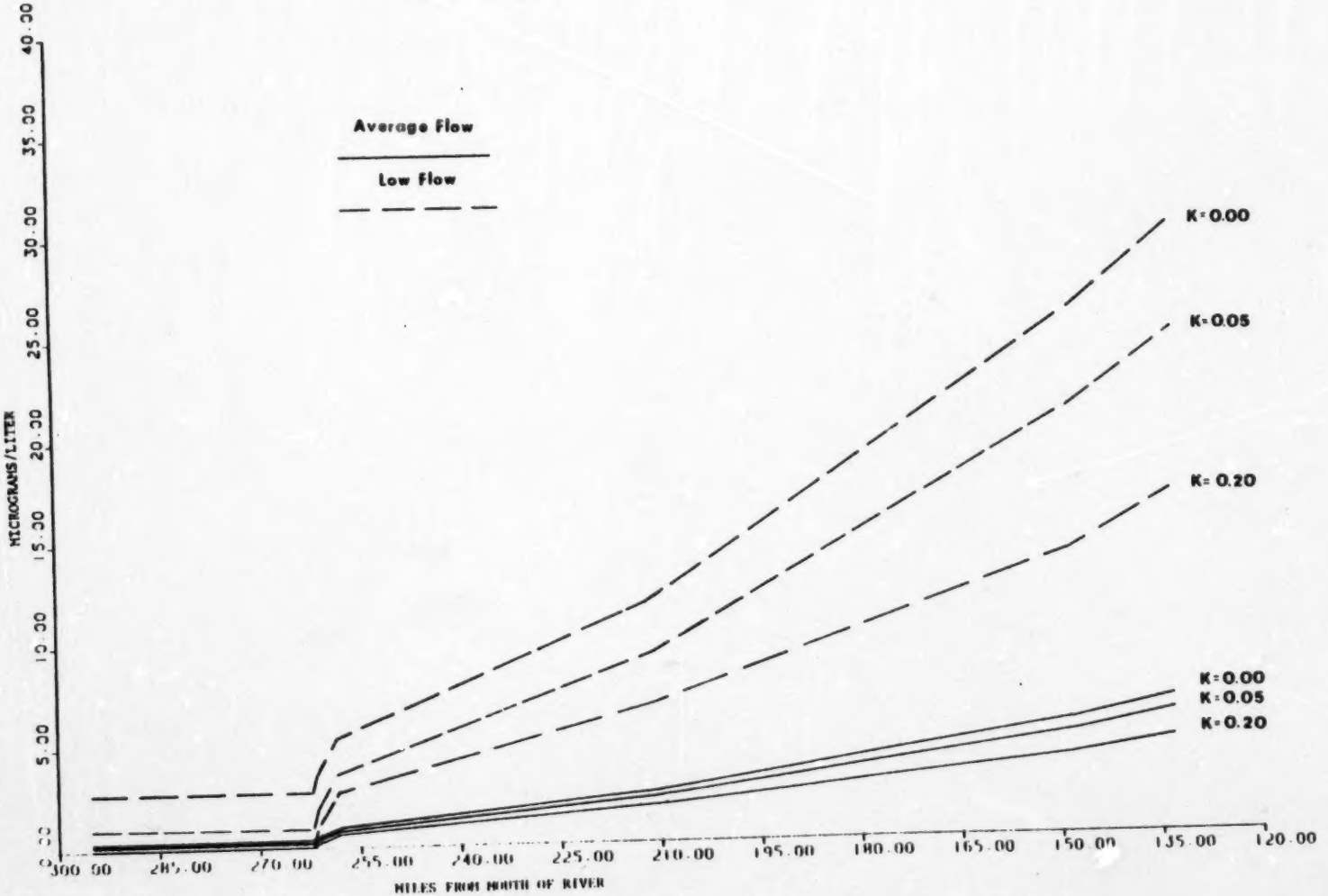



FIGURE C-11. CONCENTRATION PROFILES FOR PHENOL

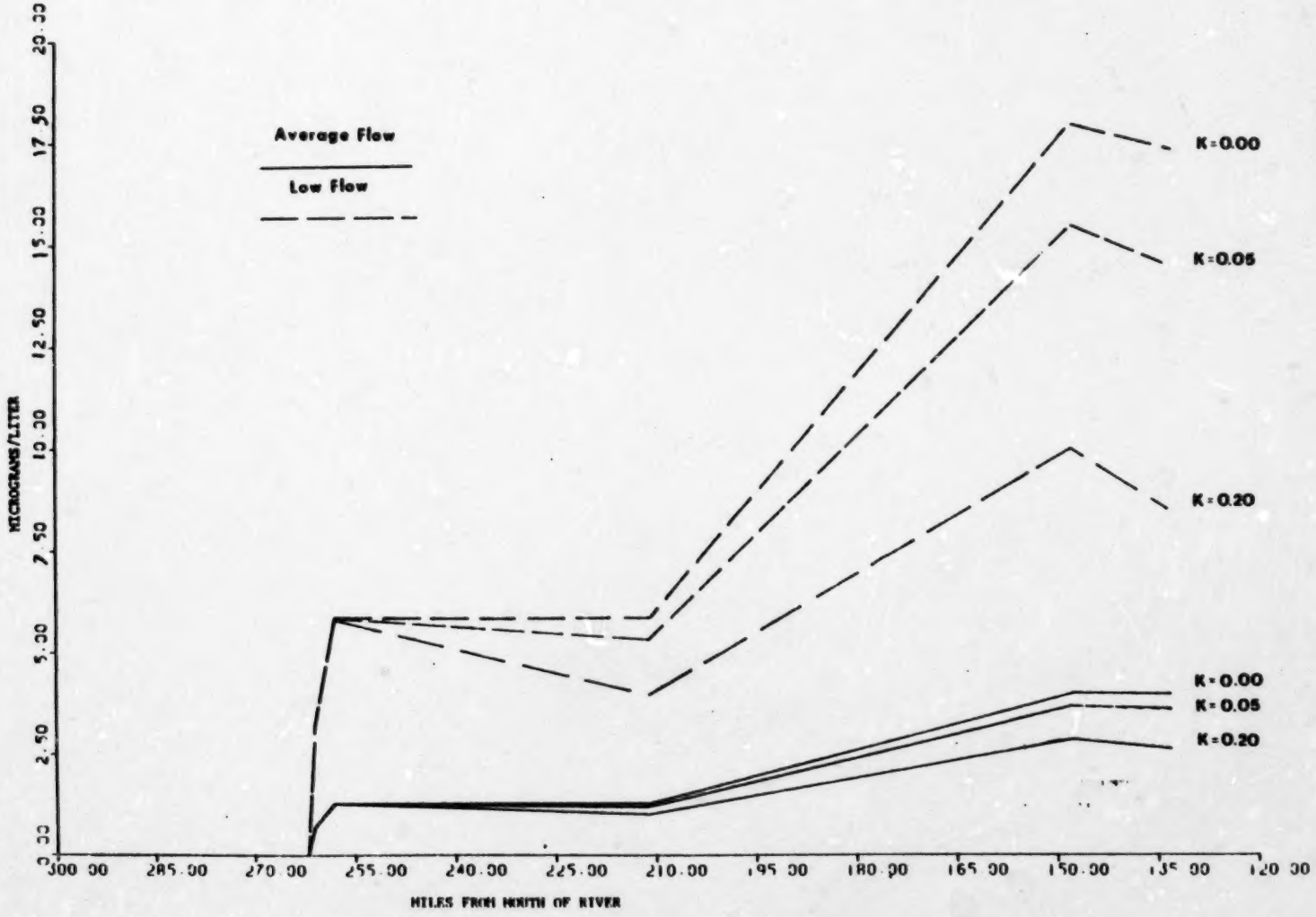



FIGURE C-12. CONCENTRATION PROFILES FOR NITROBENZENE